HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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CONTENTS

FOR AUGUST, 1952

VOLUME 49 NUMBER 8

ARTICLES

Relay Circuits for Operating Burner Controls 71
W. G. Holzbock
Network Analyzer Solves Pipeline Problems 77
Origin of Noise in Copper Pipe 78
T. W. Reynolds
Mobile Laboratory Collects Heating Data 79
Condensation Control in Buildings 80
C. E. Lund
Low-Inertia, Low-Resistance Heat Flow Meter Developed 84
Snow Melting System Practice and Design 85
J. L. McKinley
Theory vs. Practice in Radiant Heating—Part 5 99
T. N. Adlam
Instrumentation for Testing Refrigeration Products 104
H. R. Ball
Small Thermal Conductivity Probe Designed 116

REFERENCE MATERIAL

SECTION—Dust Collection Equipment 87
J. M. Kane
DATA SHEET—Solar Radiation in Cool and Cold Months ..... Opposite 146

DEPARTMENTS

Washington News—Loring F. Overman 4
Briefly Stated 66
News of Equipment and Materials 106
New Catalogs ..... Opposite 114
What Would You Do? 115
Product Applications 117
Experience is my Classroom—T. W. Reynolds 119
Abstracts and Reviews 120
News of the Month 122
What Readers Say 132
Canadian Degree-Days for May, 1952 136
Getting Personal 136
Coming Events 138
Degree-Days for June, 1952 140

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THIS MONTH'S COVER

Dust collection system in a large southern foundry carries off the dust resulting from portable grinding and chipping equipment. This design has proven effective and has resulted in good utilization of exhaust air volume. Photograph courtesy of American Air Filter Co., Inc.

Washington News

LORING F. OVERMAN

AS the steel strike neared the settlement stage, Washington defense agencies began the study of what happened, and what next? Several things were clear:

(1) Full impact of the steel lost during the weeks of idleness would not be felt for months.

(2) It would take years for the 600,000 steel workers to catch up, via the increased wages allowed, the amounts lost during months of shut-down plants.

(3) The million or so workers in related industry—idled by shortages of steel—would find their supporting role extremely expensive.

(4) A new pattern of price increases to reflect wage increases would become "government policy." This could be expected to set off a new inflationary spiral, unless perhaps the cost of the steel strike itself, and other deterrents to spendable income, may have set price ceilings more effectively than any OPS edict.

When Snow Flies

Full impact of the strike will be felt, Washington believes, after the snow flies and hundreds of ore boats are imprisoned in ice. All during June and July, when the boats are normally hurrying back and forth over the liquid highways, their crews have been on unpaid vacations. Come Winter, the money the crews would have earned, and the ore their boats would have carried, will be missing from the nation's economy.

This means, of course, that as the months pass, steel shortages will become increasingly apparent. So the planners must again take over, dividing the reduced supply as fairly as possible among those who can prove the greatest need, or tell the most convincing story.

Task Committee Busy

Informed that the steel strike was nearing settlement, NPA officials held a two-day conference in Washington in mid-July to lay tentative plans to take over when steel again begins to move. The one thing agreed upon is that steel inventories will have to be put on an emergency basis, much shorter than the 45-day limit provided in CMP Regulation 1. It was that inventory period, incidentally, which permitted the strike to go on for about that period without crippling industry entirely. The 45-day inventory rule was rather closely followed by industry, and when the strike became effective, most industries had 45 days' supply on hand.

Another sure bet is that military demands are to be met without exception, which means that firms whose inventory is near the bottom of the barrel on civilian items will have to scrape along with shortages until next spring.

Among the first civilian industries to receive special attention were the producers of cans for the season's food pack. Also scheduled for special treatment is oil country tubular goods needed for emergency use by the Petroleum Administration for Defense. A directive covering part of the production of one of the largest pipe mills is a first step which will be followed by others in the petroleum supplies field.

Post-Attack Problems

About the time everyone in Washington gets fed up with politics, filibusters, strikes, directives and bureaucracy, along comes someone with a thought so serious that it sets folks back on their heels.

Current candidate for honors in the startling department is a new unit established by the Defense Production Administration.

The new unit is called the Post-Attack Production Staff, and is headed by William J. Hoff, formerly special assistant to the defense production administrator. Mr. Hoff's unit will represent the DPA in any relationships with the National Security Resources Board, the Industry Evaluation Board, the Facilities Protection Board.

Some of the unit's jobs:

Development of plans by industry and government for rebuilding industry after enemy attack; development of plans for industry operations during the rebuilding period, and putting into effect plans for industry during the rebuilding period.

Like the insurance policy, the Post-Attack Production Staff is probably necessary. But may its plans never be used!

Standby Price Controls Urged

Congress pulled sort of a mean trick on price control officials. In extending the controls Congress cut off half of the agency's funds, making personnel cuts mandatory. As the staffs fade away, OPS is exempting a number of items from control—but its officials are already looking ahead to the date when all OPS activities are scheduled to cease, April 30, 1953.

Instead of permitting such a thing to happen, allowing prices to follow the system which made this country great, OPS folks believe it would be best to have a set of standby controls ready to put into operation whenever such an emergency as Korea results in unusual circumstances.

Price officials believe that the country may find itself in such periods of partial mobilization from time to time over the period of the next decade or so. Assuming that inflationary pressures have eased by next spring, and that direct controls can be removed without resulting in marked upward price trends, OPS officials believe that a small standby organization should be retained and ready to act in the event Congress should again decide that such action should be taken.

Stretchout Under Discussion

Easing metal supplies, and a desire to be the World's No. 1 military aviation power, is said to be responsible for recent joint conferences between Defense Department and the Defense Production Administration. Subject of the conference was the so-called stretchout—the recent decision to spread the military program out over a longer period of time, particularly the production of planes. The stretchout idea in plane manufacture is understandable, for advancement is so rapid that test models are hardly

BACKING YOU UP ON THE BIG JOBS...

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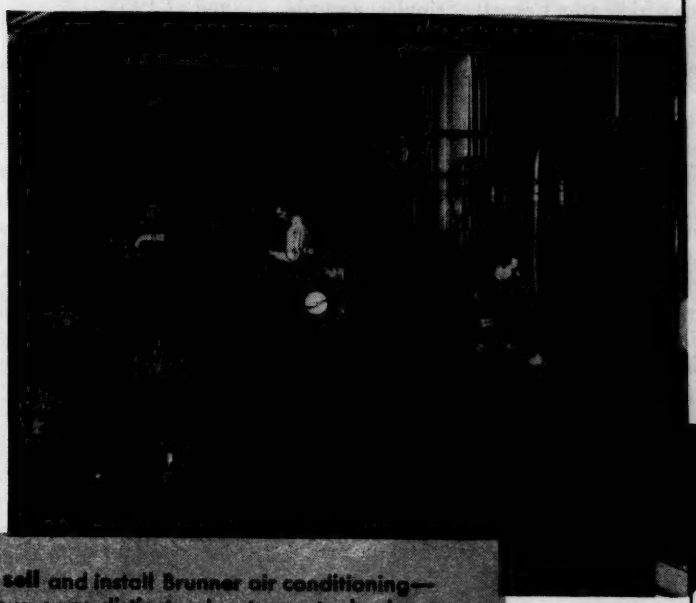

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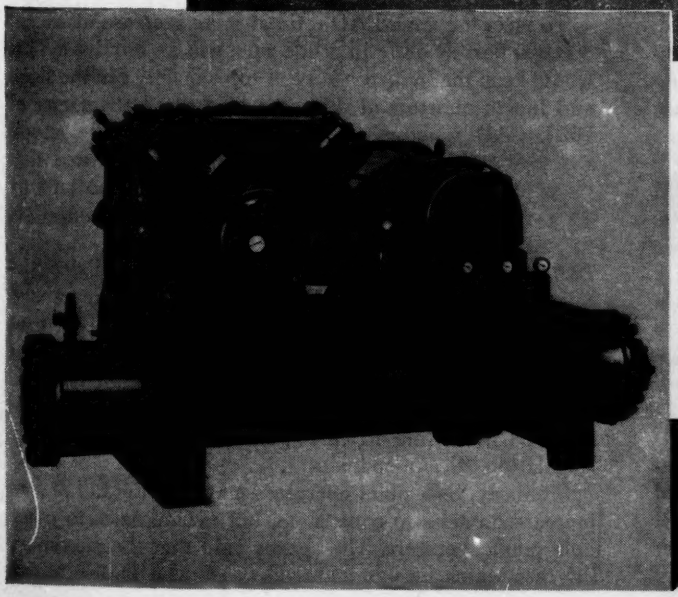

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in the air before some spectacular improvement is off the drawing boards.

So the Defense Department, understandably, has reasoned that it would be best to await the best before freezing designs. Unfortunately, the enemy has proceeded with some M.I.G. designs which aren't exactly cripples, according to reports from Korea. So the Air Force finds itself with better but fewer planes, at a time when more would be reassuring.

So they're studying means of freezing designs and standardizing models earlier in the game, methods of speeding up research and development; how to cut off production of obsolete models promptly, clearing the production lines for things new, and improved production and inspection methods all the way up the line.

Small Defense Plants Active

There is increasing activity in the Small Defense Plants Administration. The agency's program has been stepped up to include additional personnel in Washington and in 15 field offices. Until recently, SDPA had little authority other than advisory in channeling military procurement to small business, although its activities were approved by Congress and military departments alike.

SDPA is now authorized to certify small business firms to the Defense Agencies as competent to accept specified defense contracts. The certificates must be accepted by the contracting officer, and the agency is therefore empowered to act as a check on procurement officials. The certificates rule on both the financial and technical ability of the firm to do the job. SDPA's loan functions take care of the financial problems which have, in the past, kept small business and big contracts apart. When the military is satisfied with the contractor's technical qualifications, SDPA can step in and bolster the small firm's pocketbook.

SDPA Administrator Telford Taylor suggests that firms interested contact local offices of the Small Defense Plants Administration. When the field office finds that an applicant is eligible under the program, the firm fills out and forwards to Washington headquarters a form SDPA 74, along with field office recommendations.

Post-Defense Market Study

Offsetting the startling nature of the Post-Attack unit in the Defense Production Administration is a new project sponsored by the Department of Commerce and the Committee for Economic Development. The study is being undertaken to map opportunities for business after defense orders start to slip in late 1953, according to Commerce Secretary, Charles Sawyer. Figuring mid-1953 as the date for the peak of the defense program, the study is designed to consider the conditions that will exist after that date. A similar study, called "Markets After the War," was made by Commerce and the CED late in World War II. In a year when most of the economists were prophesying a post-war depression, the joint study correctly forecast a vigorous economy operating in response to high consumer demand.

Washington Miscellany

Natural Gas Liquid Goal Up. A substantial further expansion of facilities for producing and processing natural gas liquids—beyond goals originally announced on April 2 by the Defense Production Administration—has been agreed upon. April target was to increase production by 131,000 barrels a day by the end of 1953. The new program calls for additional capacity of 60,000 barrels a day in the last six months of 1952, with 120,000 more barrels daily by the end of 1953. The expanded facilities would provide a total capacity of 1,040,000 barrels daily by the end of 1953.

The adjustment, NPA explains, will be made to handle the natural gas liquids which will be produced as a result of current drilling operations. The natural gas liquids include liquefied petroleum gases and natural gasoline, recovered in the processing of natural gas. The petroleum gases are used for domestic and industrial fuel and in the manufacture of synthetic rubber and other chemicals. Natural gasoline is used in blending aviation and automotive gasoline.

Water, Water Everywhere. One of the most recent research projects authorized in Washington appears to have little to do with heating, ventilating and air-conditioning, but perhaps it will win its way into this column via the pipe, elbow and valve route. In one of its last-minute actions before adjournment, Congress appropriated money to finance the coordination of scientific and practical research to purify and utilize salt and brackish waters.

The program takes note of the fact that a shortage of fresh water is being reported with increasing frequency in cities and industrial areas. Yet the areas involved are usually close to seas or other sources of salty or brackish water.

The program, authorized in HR 6578, signed by the President, sets up appropriations of $400,000 annually for the next five years for research through universities, private industries and other organizations, under the direction of the Secretary of the Interior.

Near-Shortage of Fuel Oil Likely

Forecasting a 17% increase in demand for fuel oils during the next nine months on the East and Gulf Coasts, the Petroleum Administration for Defense has urged refiners serving those areas to increase production. The added demand, PAD officials said, will be due to several factors. More burners are being installed, the demand for diesel fuel is up, and a normal winter would itself require at least 10% more gallonage than the mild winter of 1951-52.

To meet the goal, PAD estimates, an increase of almost 300,000 barrels daily in crude runs will be required. That would keep the industry busy at top capacity for the third and fourth quarters of this year, and the first quarter of 1953. PAD spokesmen said they do not believe an oil shortage to be inevitable this winter, but indicated that the supplies will be tight. Conferences in Houston on July 21 and in New York on July 30 were called in an effort to outline plans of action.

Eastern Seaboard Price Increase. The Office of Price Stabilization has ruled that Eastern seaboard refiners and terminal operators are entitled to charge the full .8 cent a gallon price increase on No. 2 heating oil when making sales to consumers and not to other refineries, terminal operators, or bulk plants. Authority for the increase is included in Ceiling Price Regulation 17, Supplementary Regulation 10, Amendment 1.

Similarly, bulk plant operators may take the full .8 cent increase on sales to consumers, but not on sales to other bulk plant operators. The agency said that the maximum increase which may be charged consumers is .8 cent.

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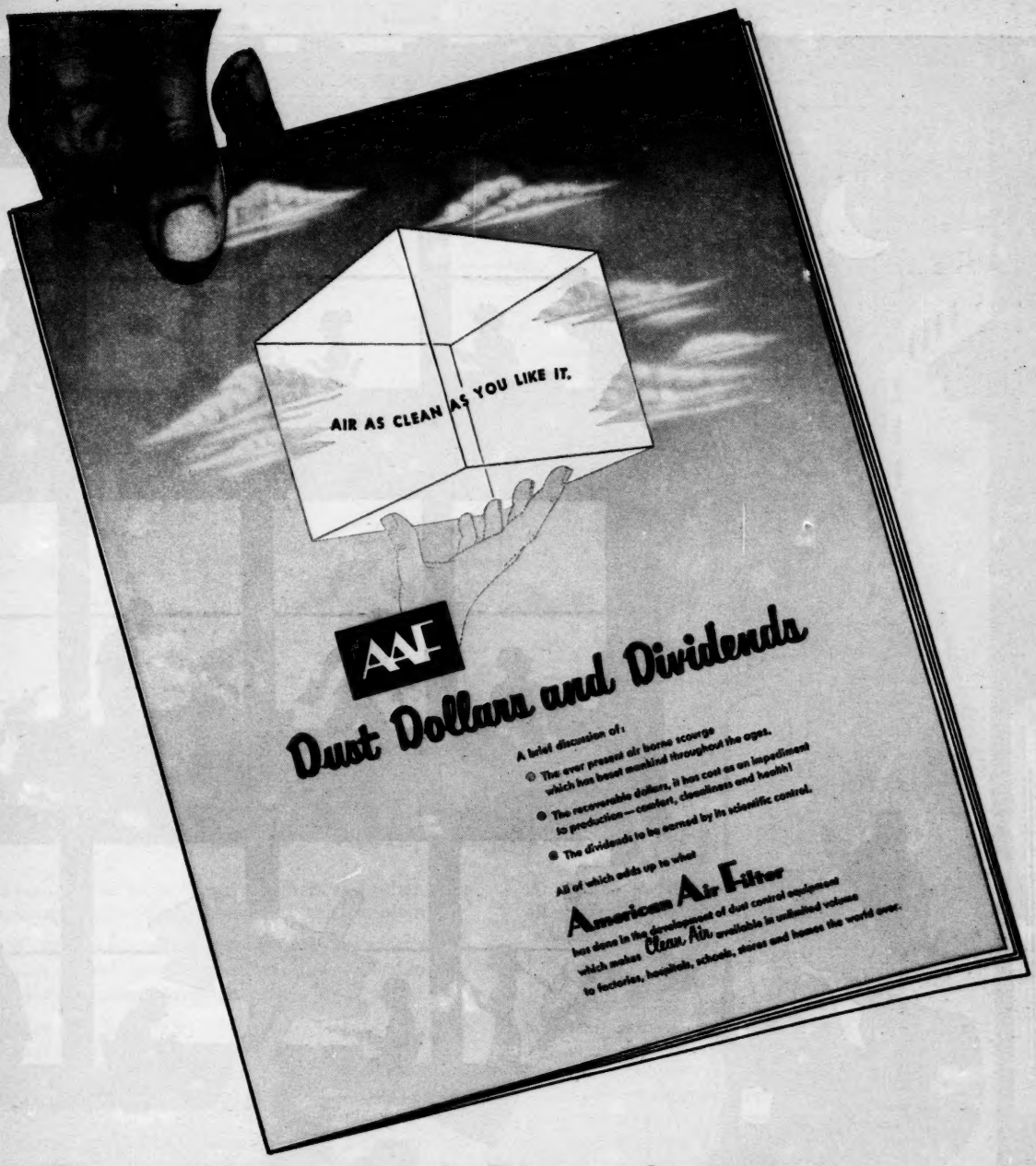
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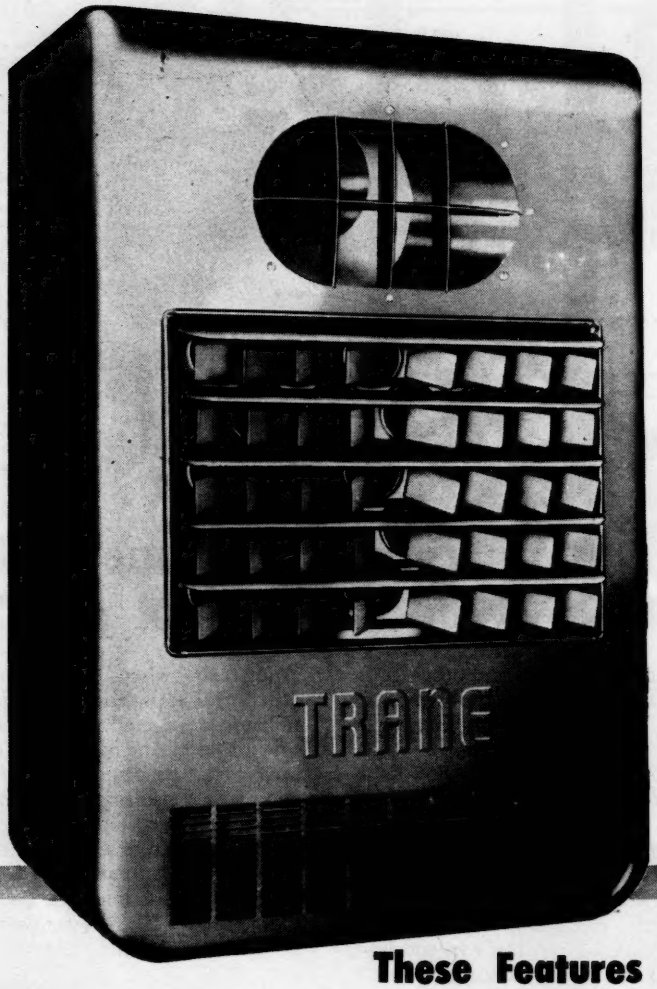

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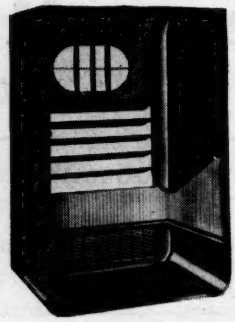

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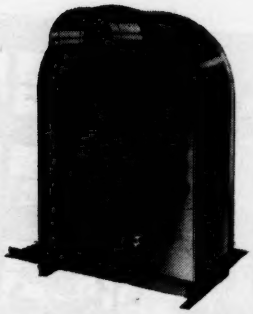

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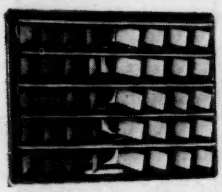

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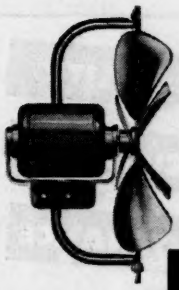

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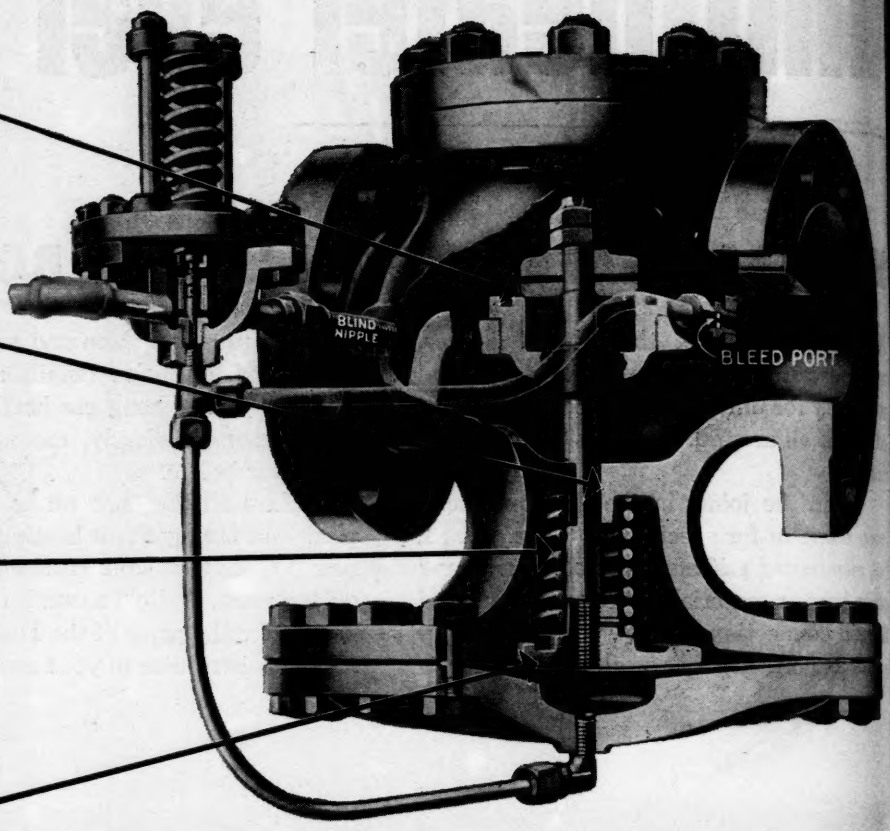

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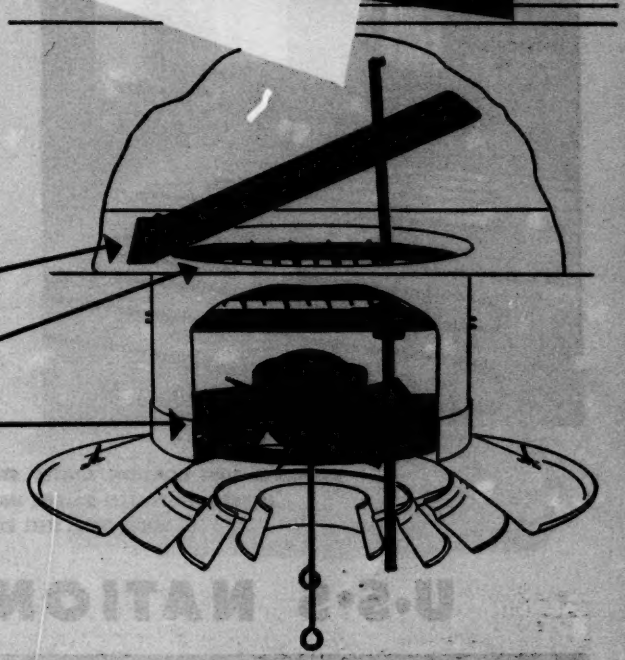

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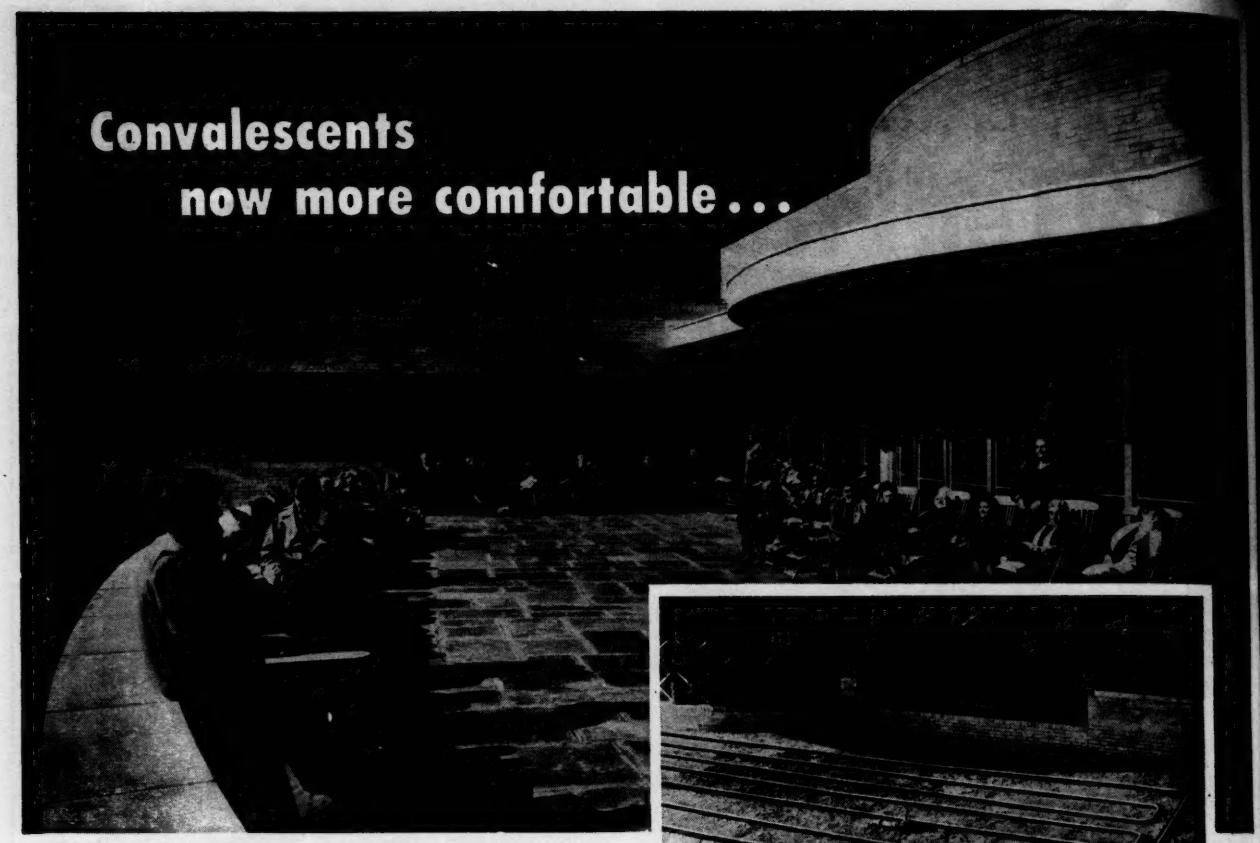

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It takes only a few minutes to learn how much better your heating can be with American Blower Unit Heaters.

And, for years after you install them, you'll get the benefits of their lower fuel costs, lower maintenance costs and exceptionally long life.

Heavy duty coils, unobstructed outlets for maximum heat diffusion, completely enclosed moving parts are but a few of the quality features which make these units outstanding. They carry Certified Ratings—and are sound-rated, too.

For data, phone the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

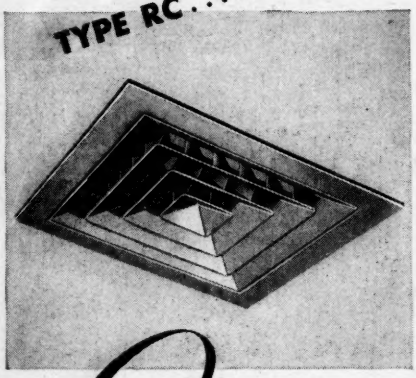
AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

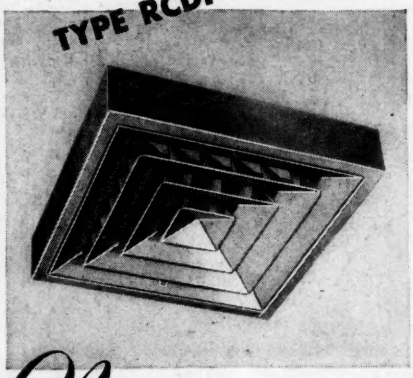
Serving home and industry

ARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

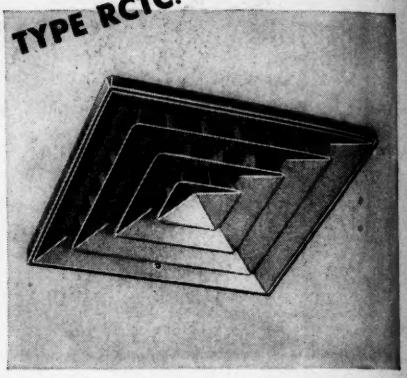
TYPE RC . . . For Standard Installations



TYPE RCDF . . . For Drop Frame Installations



TYPE RCTC. . . For Tile Ceilings



Announcing New...

AGITAIR® TYPE RC

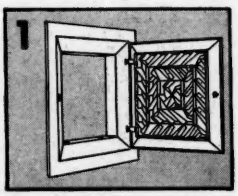
WITH REMOVABLE DIFFUSER CORE

. . . and three distinct styles of mounting frames. Highly efficient in performance, attractive in appearance and designed to meet any and all conditions.

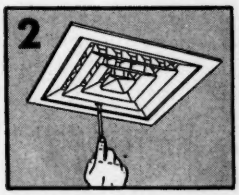
The New AGITAIR diffusers are the result of painstaking research to provide you with square and rectangular air outlets that are practical from every standpoint. The removable core with unlimited air distribution pattern possibilities, and the new mounting frames incorporate many AGITAIR exclusive features and desirable functional qualities.

AGITAIR "RC" diffusers are available in a wide variety of sizes and patterns . . . easy and economical to install. For complete engineering and application data contact your nearest AGITAIR representative or write direct to Air Devices Inc.

1-2 YOU'RE THRU...



Insert diffuser "slide hinges" into frame slots



Turn mounting lock 90° with screw driver

WRITE FOR COMPLETE INFORMATION

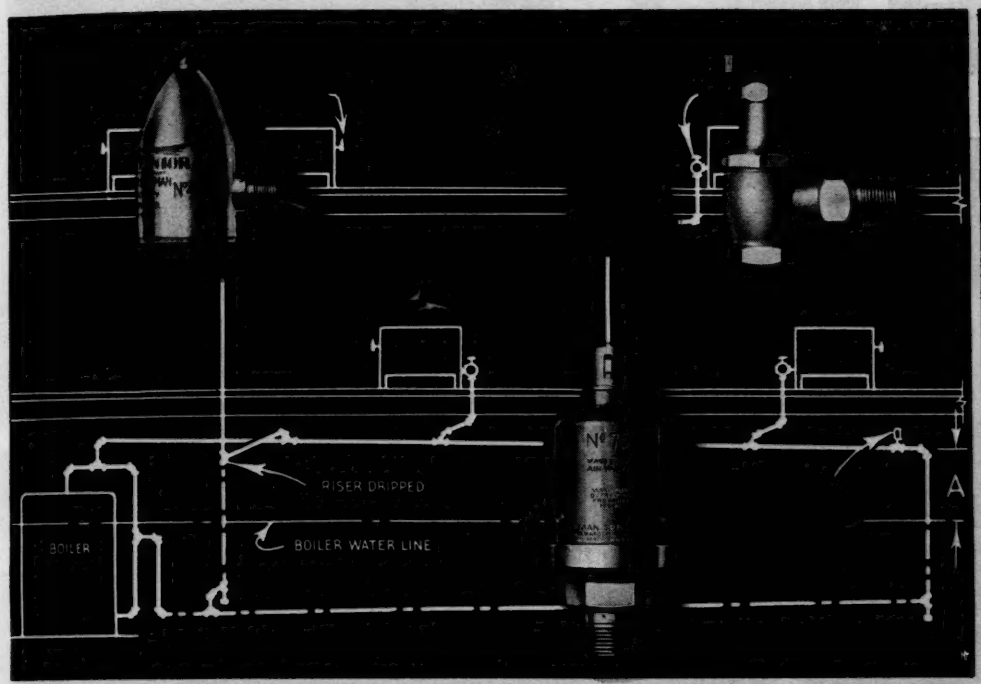
AIR DEVICES INC.

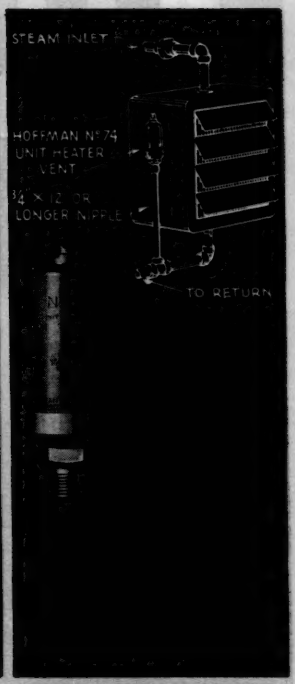
17 EAST 42nd STREET • NEW YORK 17, N. Y.

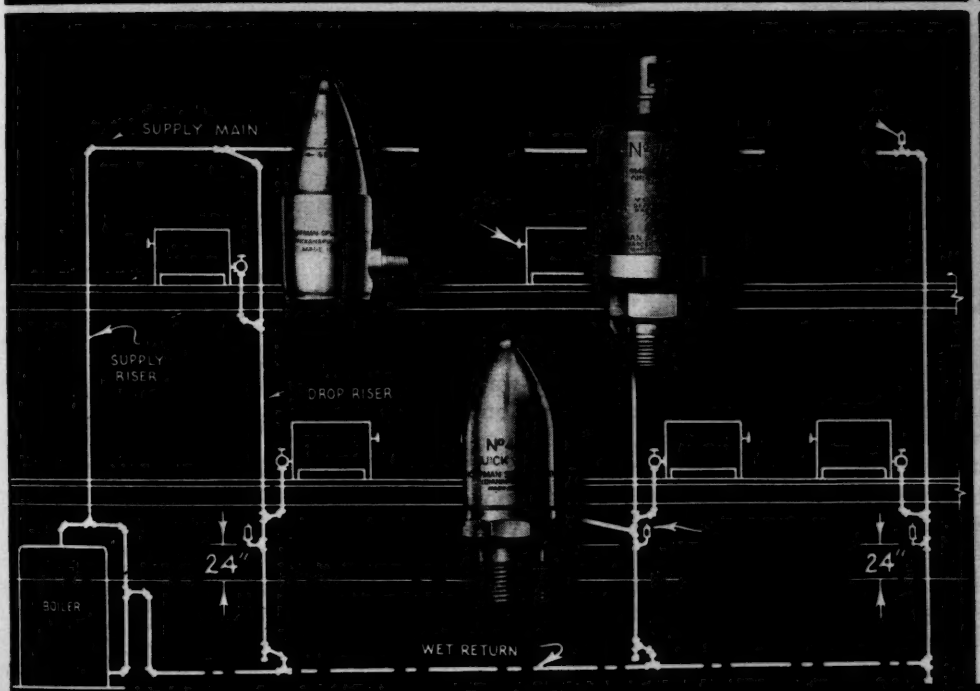
AIR DIFFUSERS • AIR AND GREASE FILTERS • EXHAUSTERS

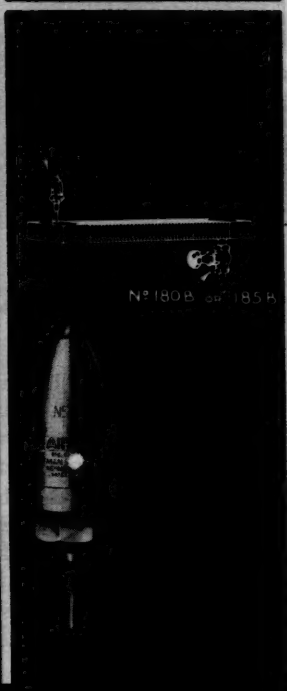
HOFFMAN VENTING VALVES

A TYPE FOR EVERY HEATING SYSTEM









HOFFMAN SPECIALTY MFG. CORP. • 1001 York Street, Indianapolis 7, Indiana

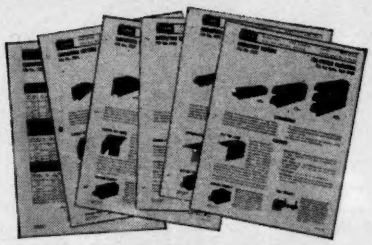
Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensation Pumps — Sold by Leading Wholesalers of Heating and Piping Equipment

. . .and doing more than ever before

Here's the last word in low-cost, space-saving, along-the-wall heating. Dunham's new Fin-Vector Radiation fits in functionally almost anywhere . . . in any type of building . . . at any height along outside walls.

Light in weight . . . but long on performance . . . Fin-Vector goes up fast, distributes heat evenly in long runs, looks like new . . . works like new . . . even after years of hard knocks.

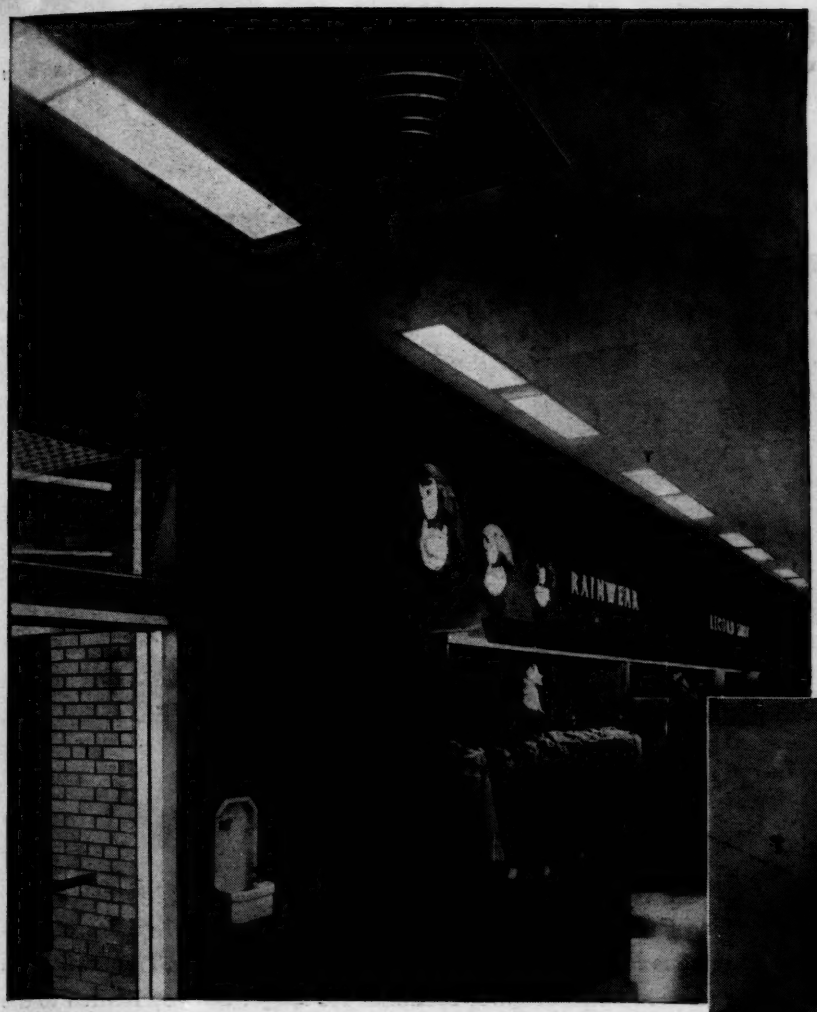
Cover sections lock neatly together into one long cabinet. Choice of sloping top, flat top, or expanded metal covers; full line of accessories for a sturdier, better looking, better heating installation.



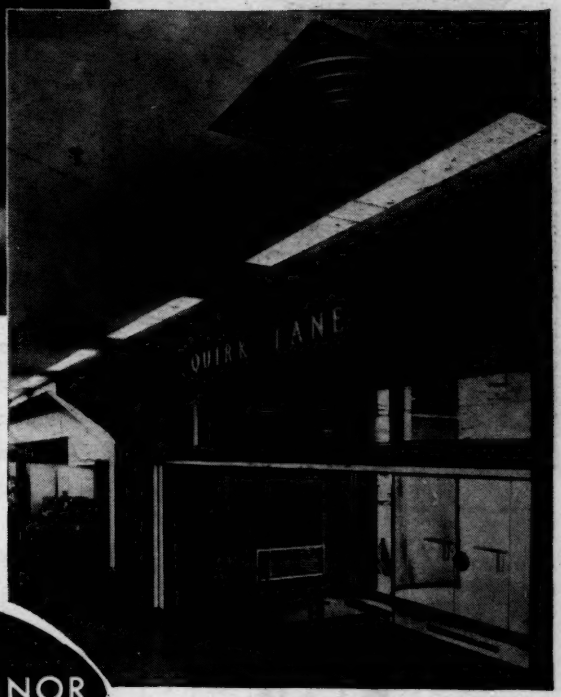
Send For Free Literature. Data Sheets 1256-61 fully describe and illustrate Fin-Vector features, capacities and types. Please write for your free copies to Dept. 16, C. A. Dunham Company, 400 W. Madison St., Chicago 6, Illinois.

DUNHAM **FIN-VECTOR RADIATION**

ANOTHER QUALITY PRODUCT OF C. A. DUNHAM COMPANY • CHICAGO • TORONTO • LONDON



Design Engineers: Abbott, Merkt and Company, Inc.
Design Architects: Kahn and Jacobs
Consulting Engineers: Edward E. Ashley



NEW HECHT STORE *chooses...*

● Handsome efficient Kno-Draft Air Diffusers bring conditioned air – gently, evenly, and *without drafts* – into The Hecht Co.'s new Parkington-Arlington store at Arlington, Virginia.

Here, as with every Kno-Draft job, a lot less preliminary figuring had to be done because Kno-Draft Air Diffusers are adjustable *after* installation. This not only reduces slide rule work but assures the customer the exact comfort level desired. Air volume and direction of flow can be regulated with no other tool than a screw driver.

Kno-Draft *Adjustable* Air Diffusers are being specified for more and more commercial and industrial applications. Get the full story on their many engineering advantages. Mail the coupon today to W. B. Connor Engineering Corporation, Danbury, Connecticut.

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adjustable air diffusers

W. B. CONNOR ENGINEERING CORP.
Dept. J-82, Danbury, Connecticut

Please send me the *new edition* of the Kno-Draft Data Book—without obligation, of course.

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Position_____

Company_____

Street_____

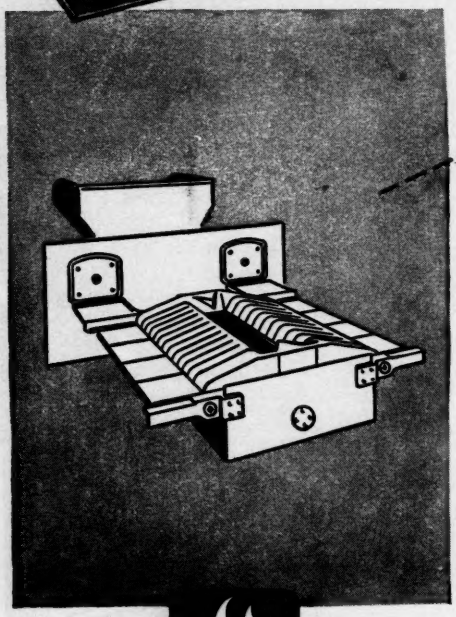
City_____ **Zone**_____ **State**_____

Why not buy a stoker that will burn either...

ANTHRACITE

or

BITUMINOUS



The C-E Skelly Stoker will burn satisfactorily *all* grades of bituminous coal as well as the smaller sizes of anthracite. Think what this means in terms of lower fuel bills. No longer are you limited to the more expensive, better grades of coal. The C-E Skelly Stoker permits the use of the most economical type of coal available in your locality. This flexibility in the choice of coals enables you to keep your heating costs at a minimum. In fact, it makes your purchase an *investment* rather than an *expense.*

When you consider that the cost of fuel burned on a stoker often greatly exceeds the initial cost of the stoker itself, it becomes quite evident that the range of coals a stoker will burn *effectively* is a far more important consideration than the purchase price.

Moreover, the C-E Skelly Stoker assures top performance with minimum maintenance. For this stoker reflects the practical knowledge of fuels and operating conditions that Combustion has acquired in installing over 20,000 stokers of all types above residence size.

You can turn to C-E with complete confidence that you are purchasing a stoker that you can rely upon for years of dependable, economical service. Why not investigate the C-E Skelly Stoker for your next installation?

B-566

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

COMBUSTION ENGINEERING — SUPERHEATER, INC.

200 Madison Avenue, New York 16, N. Y.

JENKINS PRACTICAL PIPING LAYOUTS 61

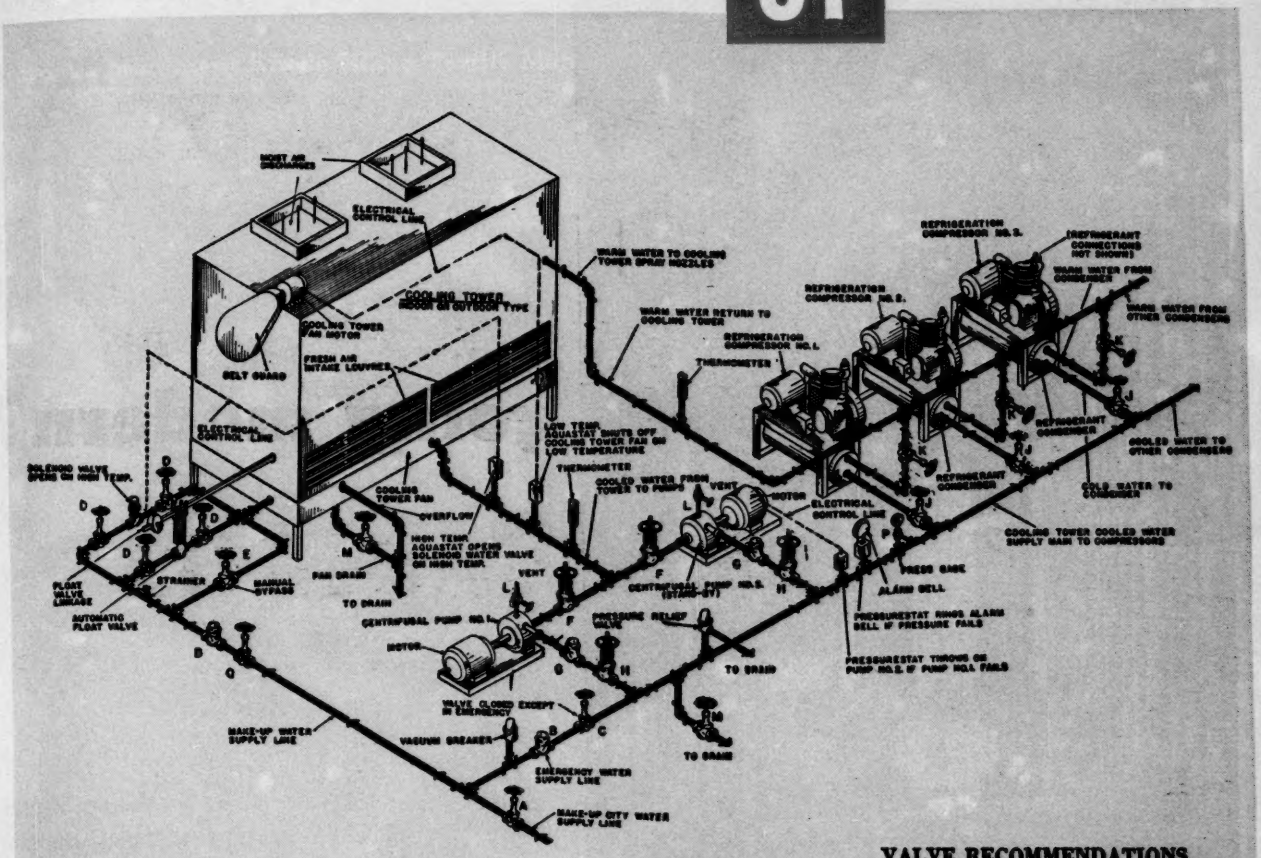

ELECTRICAL CONTROL LINE
COOLING TOWER FAN MOTOR
BELT GUARD
FRESH AIR INTAKE LOUVRES
WARM WATER TO COOLING TOWER SPRAY NOZZLES
WARM WATER RETURN TO COOLING TOWER
REFRIGERATION COMPRESSOR NO. 3.
REFRIGERANT CONNECTIONS NOT SHOWN
WARM WATER FROM CONDENSERS
REFRIGERATION COMPRESSOR NO. 2.
REFRIGERATION COMPRESSOR NO. 1.
THERMOMETER
REFRIGERANT CONDENSER
COOLED WATER TO OTHER CONDENSERS
COLD WATER TO CONDENSER
LOW TEMP. AQUASTAT SHUTS OFF COOLING TOWER FAN ON LOW TEMPERATURE
COOLED WATER FROM TOWER TO PUMPS
VENT
MOTOR
ELECTRICAL CONTROL LINE
COOLING TOWER COOLED WATER SUPPLY MAIN TO COMPRESSORS
SOLENOID VALVE OPENS ON HIGH TEMP.
COOLING TOWER PAN
OVERFLOW
HIGH TEMP. AQUASTAT OPENS SOLENOID WATER VALVE ON HIGH TEMP.
PAN DRAIN
TO DRAIN
STRAINER
MANUAL BYPASS
FLOAT VALVE LINKAGE
AUTOMATIC FLOAT VALVE
CENTRIFUGAL PUMP NO. 1.
CENTRIFUGAL PUMP NO. 2. (STAND-BY)
PRESSURE RELIEF VALVE
MOTOR
VALVE CLOSED EXCEPT IN EMERGENCY
TO DRAIN
MAKE-UP WATER SUPPLY LINE
VACUUM BREAKER
EMERGENCY WATER SUPPLY LINE
MAKE-UP CITY WATER SUPPLY LINE
PRESS. GAGE
ALARM BELL
PRESSURESTAT RINGS ALARM BELL IF PRESSURE FAILS
PRESSURESTAT THROWS ON PUMP NO. 2 IF PUMP NO. 1 FAILS

Diagram by Huxley Madeheim Consulting Engineer

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VALVE RECOMMENDATIONS
For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Services
A	1	Fig. 47 Bronze Gate	Main Water Supply Shutoff
B	2	Fig. 352 Swing Check	Prevent Backflow
C	1	Fig. 47 Bronze Gate	Emergency Water Supply Shutoff
D	4	Fig. 47 Bronze Gate	Automatic Valve Shutoff
E	1	Fig. 106-A Bronze Globe	Manual Bypass of Automatic Valves
F	2	Fig. 368 Bronze Gate	Pump Suction Shutoff
G	2	Fig. 352 Br. Swing Checks	Prevent Backflow to Pumps
H	2	Fig. 368 Bronze Gate	Pump Discharge Control
J	3	Fig. 106-A Bronze Globe	Control Water to Condensors
K	3	Fig. 370 Bronze Gate	Condensor Discharge Shutoff
L	2	Fig. 743-G Bronze Needle	Pump Vent Control
M	2	Fig. 106-A Bronze Globe	Drain Valves
P	1	Fig. 743-G Bronze Needle	Pressure Gage Control
Q	1	Fig. 47 Bronze Gate	Make up Supply Line

How to plan a COOLING WATER SYSTEM FOR REFRIGERATION COMPRESSORS

Facilities for cold storage of frozen and perishable foods in super markets, hotels, restaurants and institutions are being expanded rapidly, creating a demand for small refrigeration compressors like the one illustrated.

In this cooling system provisions have been made to cope with all emergency conditions. These include piping for re-use and conservation of water. Moreover, should temperature of the water in the system rise above normal, fresh water is automatically introduced through a solenoid valve operated by a thermostat in the supply line.

Duplicate water circulating pumps insure continuous cool water supply to compressors since water-pressure failure in one automatically cuts in on the standby pump. To provide for the remote possibility of both pumps failing, an alarm system warns operator to turn on the emergency manually-controlled water supply.

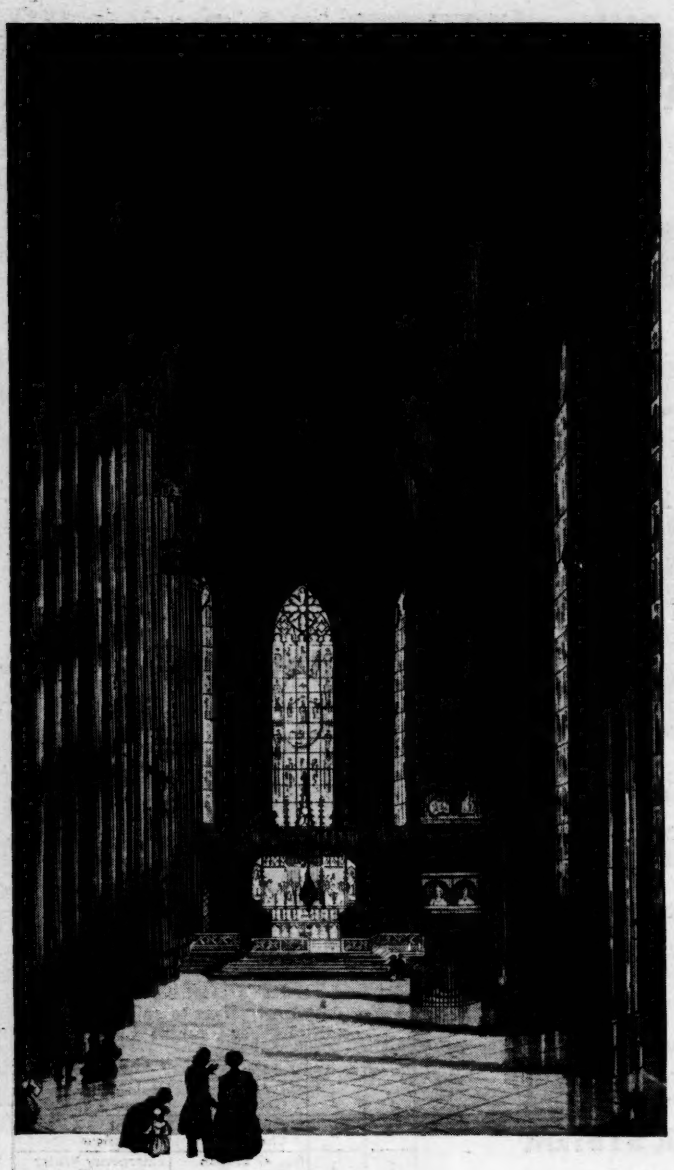
Consultation with piping engineers is recommended when planning any major piping installations.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from Jenkins complete line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

COMPLETE DESCRIPTION AND ENLARGED DIAGRAM OF THIS LAYOUT FREE ON REQUEST. Includes additional detailed information. Ask for Piping Layout No. 61.

TRADE JENKINS MARK

Jenkins Bros



going modern?

In design, it's hard to say. But you can be sure that churchmen are seeing the advantages of churches that offer modern comfort.

Surveys show that in the next few years, a large number of churches will be air conditioned.

It's one of the best investments a church can make. It increases attendance during summer months. It creates more interest in services by eliminating discomfort and traffic noises. And it means fewer cleaning and redecorating bills.

But church installations can present difficult problems. Ducts must be concealed, equipment must be especially quiet. The system must be able to handle infrequent building capacities and sudden cooling loads. And peculiar construction features, like high domes, can add to the problem.

But with Carrier's line of matched products, you can build a system around any problems. It's equipment designed and built by men with half a century of air conditioning experience behind them, including some of the larger churches in the country. Carrier Corporation, Syracuse, New York *—for 50 years . . . the people who know air conditioning best.*

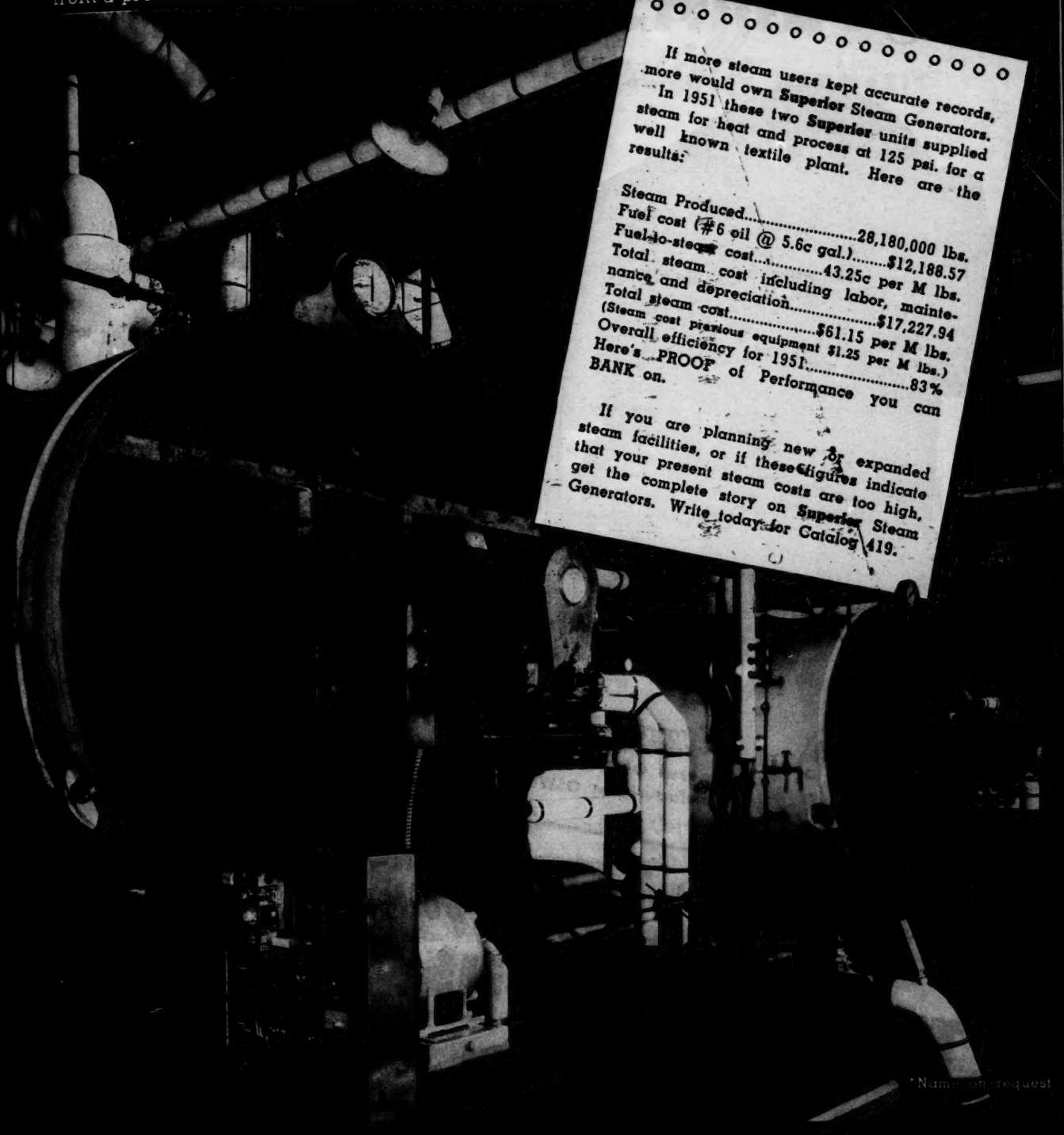
Carrier

AIR CONDITIONING / REFRIGERATION / INDUSTRIAL HEATING

accept no of economy

LOOK at these STEAM COSTS

from a prominent Rhode Island Textile Manufacturer *



If more steam users kept accurate records, more would own **Superior** Steam Generators. In 1951 these two **Superior** units supplied steam for heat and process at 125 psi. for a well known textile plant. Here are the results:

Steam Produced	28,180,000 lbs.
Fuel cost (#6 oil @ 5.6c gal.)	$12,188.57
Fuel-to-steam cost	43.25c per M lbs.
Total steam cost including labor, maintenance and depreciation	$17,227.94
Total steam cost (Steam cost previous equipment $1.25 per M lbs.)	$61.15 per M lbs.
Overall efficiency for 1951	83%

Here's PROOF of Performance you can BANK on.

If you are planning new or expanded steam facilities, or if these figures indicate that your present steam costs are too high, get the complete story on **Superior** Steam Generators. Write today for Catalog 419.

*Name on request

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR
STEAM GENERATORS

Big savings in big buildings

...WITH THE FITZGIBBONS "D" TYPE STEEL BOILER

EXTRA LARGE COMBUSTION CHAMBER for the efficient burning of any fuel — oil, gas, or coal, stoker or hand-fired.

RAPID WATER CIRCULATION induced by the concentration of heat at the high point of the fire-box crown sheet, brings *more water* in contact with *more heating surface* in a given time. The result is:

QUICK HEAT TRANSFER, with no time lag to cause waste of fuel. Here is a saving that adds up. The bigger the building the bigger the saving.

FITZGIBBONS CONSTRUCTION THROUGHOUT meaning certified flange quality steel, rigid adherence to the ASME. code in all construction details, hydro-static test before shipment, and rating as per the Steel Boiler Institute Rating Code. There are no stronger guarantees of boiler quality.

This is the quality boiler that is supplying heat in thousands of commercial and public buildings. Eighteen sizes, from 528,000 Btu to 10,200,000 Btu. For details and specifications write for the "D" Type Bulletin.

MOST ECONOMICAL IN FUEL · 1886 · THE FITZGIBBONS BOILER

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Fitzgibbons Boiler Company, Inc.

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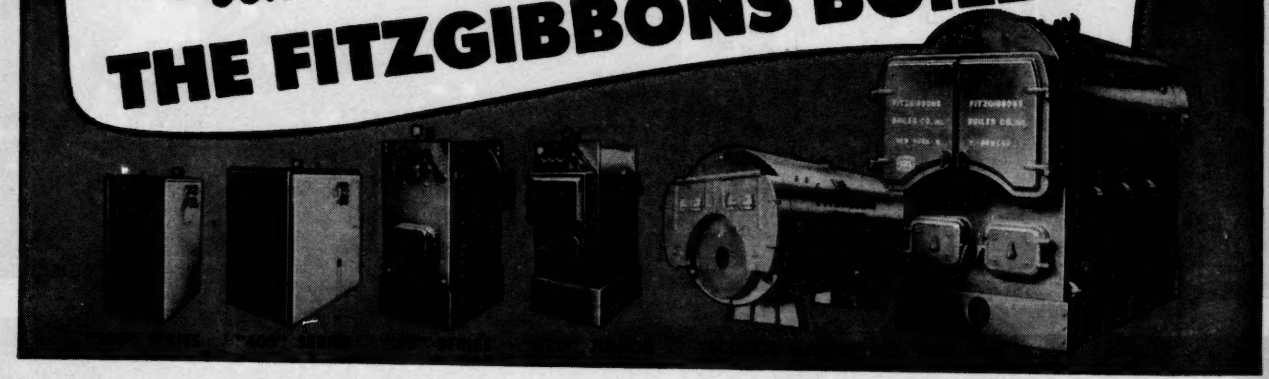
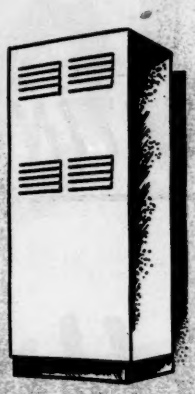
SBI

A steel boiler is a lifetime investment —sell "the best in steel boiler heat"—

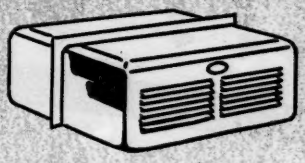
THE FITZGIBBONS BOILER®

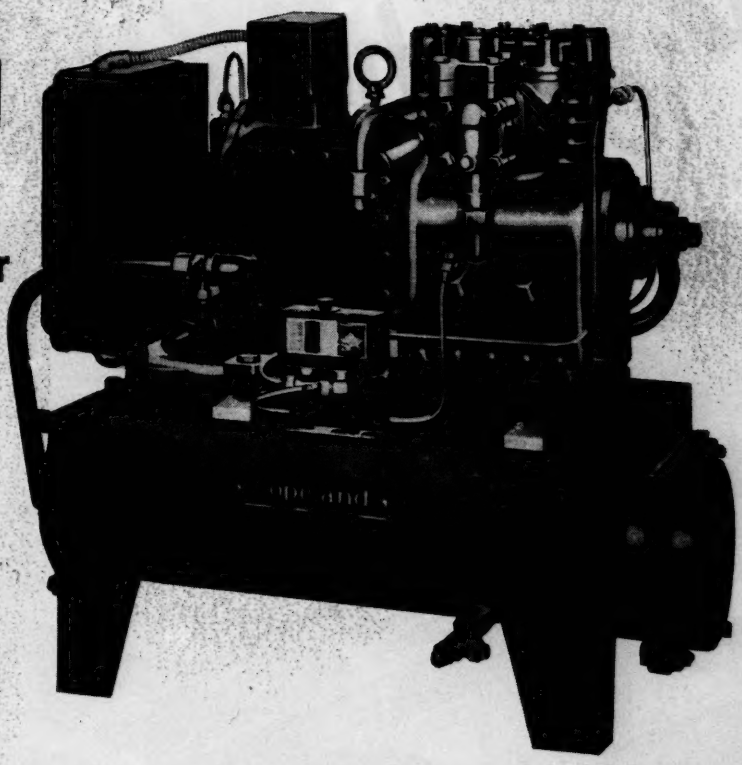




COPELAMETIC

THE *Accessible* HERMETIC



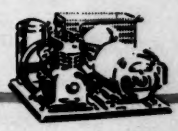


condensing units and motor-compressors for all air conditioning requirements

- ☑ COMPACT
- ☑ ECONOMICAL
- ☑ DEPENDABLE
- ☑ RUGGED
- ☑ QUIET

Copelametic is as modern as air conditioning itself. Its advanced design neatly combines the best qualities of open-type and welded-in units into one compact package. No belts, no seals, no manual oiling. It is fully accessible when the rare occasion arises.

And the Copelametic is just one star performer in our dependable line. There is a rugged Copeland unit for every application in refrigeration and air conditioning. Sizes through 7½ H.P. Write today for complete data.



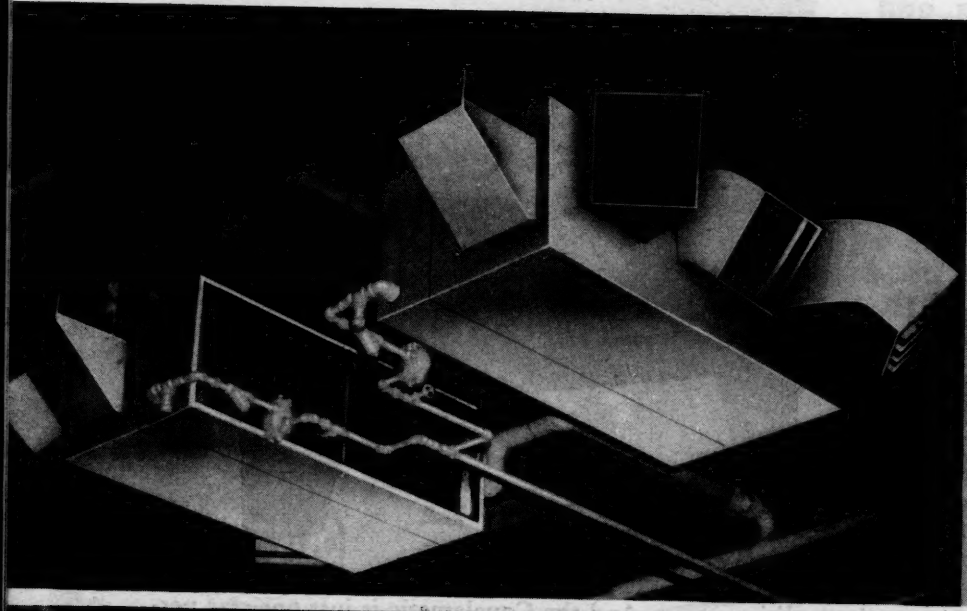
Copeland
DEPENDABLE *Electric* REFRIGERATION

COPELAND REFRIGERATION CORPORATION, SIDNEY, OHIO

"Buffalo"

Tips on Better HEATING

Pick the RIGHT Unit



ABUNDANT HE… NO FLOOR SPA… USED

"Buffalo" Lowboy Hea… can be inexpensively mou… overhead to heat entire l… production or wareho… areas. Here is a dual install… tion. Note directional outle…

LONG, NARROW SPACE-SAVER READY TO THRO… QUICK HEAT

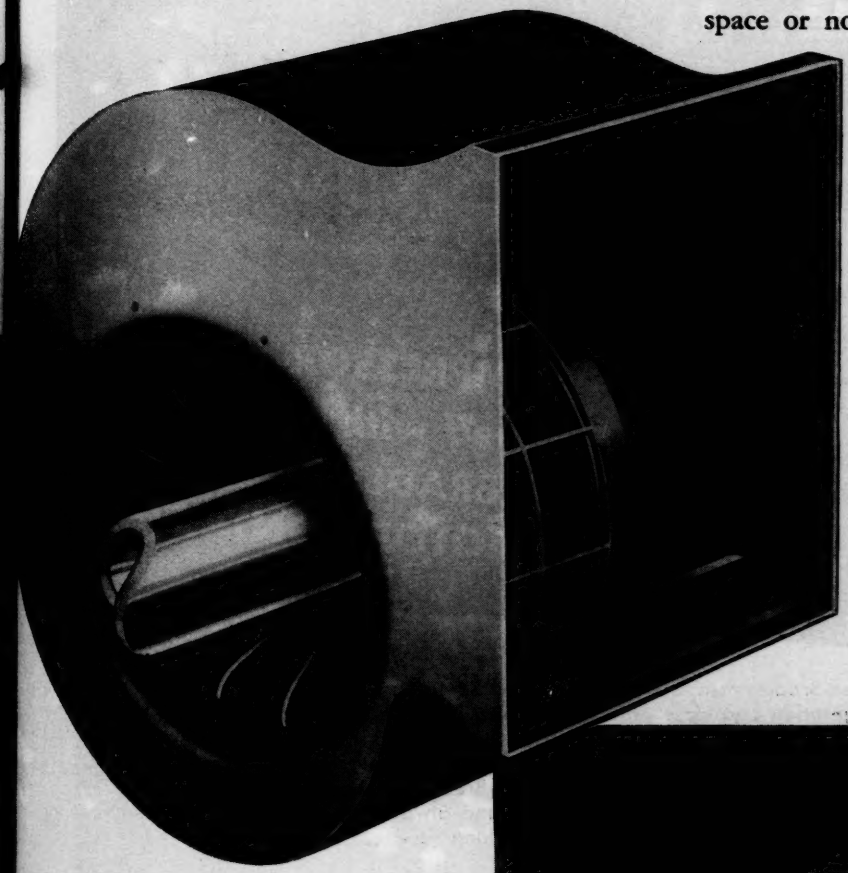
"Buffalo" Highboy Hea… are ideal for wall mounti… as in steel mill and oth… industrial service. Note be… ings recessed in dished bo… for handy outside lubricatio…

VENTILATING • PRESSURE BL…

NOW!

You can avoid worry, haste and disappointments by solving your heating problems before cold weather comes. You may need just a few small unit heaters, properly placed. You may have an exhaust system, and therefore may require heated make-up air. Or you may have an installation problem, such as cramped space or no available floor space.

The pictures here may answer some of your questions, and for further helpful facts, simply write for Bulletin 3704-A.



EFFICIENT HEAT DISTRIBUTION

is assured by smooth running "Buffalo" mixed-flow blowers plus non-freeze Aerofin coils.

FRESH AIR PLUS HEAT!

Above, a "Buffalo" Flat Suspended Lowboy with face and by-pass dampers and mixing box for handling fresh and return air. One of many combinations available.

DIAMOND JUBILEE 75TH ANNIVERSARY

BUFFALO FORGE COMPANY

480 BROADWAY

BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING HANDBOOK"

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

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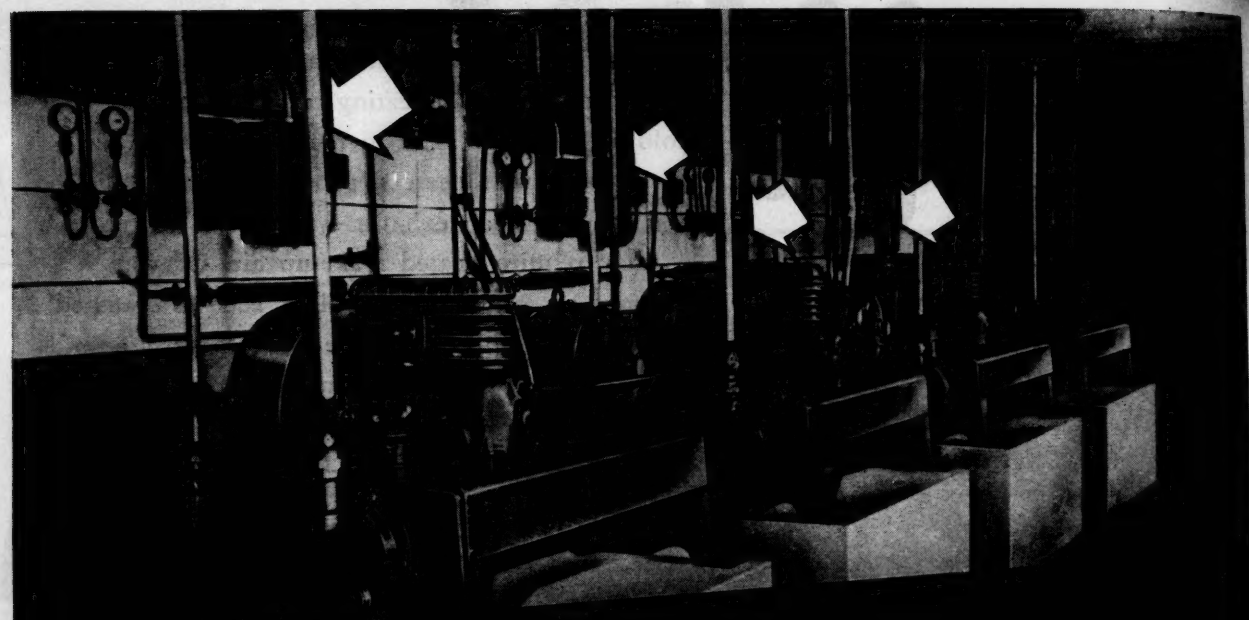


Mills Compressor Units equipped with Allen-Bradley Bulletin 709 Automatic Starters.

MILLS COMPRESSOR UNITS equipped with ALLEN-BRADLEY TROUBLE FREE MOTOR CONTROLS

A-B Quality

Why are Allen-Bradley starters so popular for refrigeration and air conditioning service? . . . because they are trouble free. Only ONE moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them!

No contact maintenance . . . Allen-Bradley silver alloy contacts never need cleaning, filing, or dressing.

Dependable overload relays . . . Allen-Bradley thermal relays are accurate and always dependable . . . even after long service.

Allen-Bradley Co., 1330 S. Second St., Milwaukee 4, Wis.

Write for this NEW Allen-Bradley Air Conditioning and Refrigeration Bulletin

ALLEN-BRADLEY SOLENOID MOTOR CONTROLS

Your GILT-EDGED SALES Opportunity

New—5-YEAR WARRANTY

For ALL Curtis Packaged Air Conditioners

Now, every Curtis Packaged Air Conditioning unit sold through franchised distributors is covered by a new, 5-year factory warranty. This includes 2, 3, 5, 7½, 10 and 15-H.P. sizes. Find out more about your profit possibilities with Curtis. Use the coupon

CURTIS REFRIGERATING MACHINE DIVISION
of Curtis Manufacturing Company
1999 Kienlen Avenue • St. Louis 20, Missouri

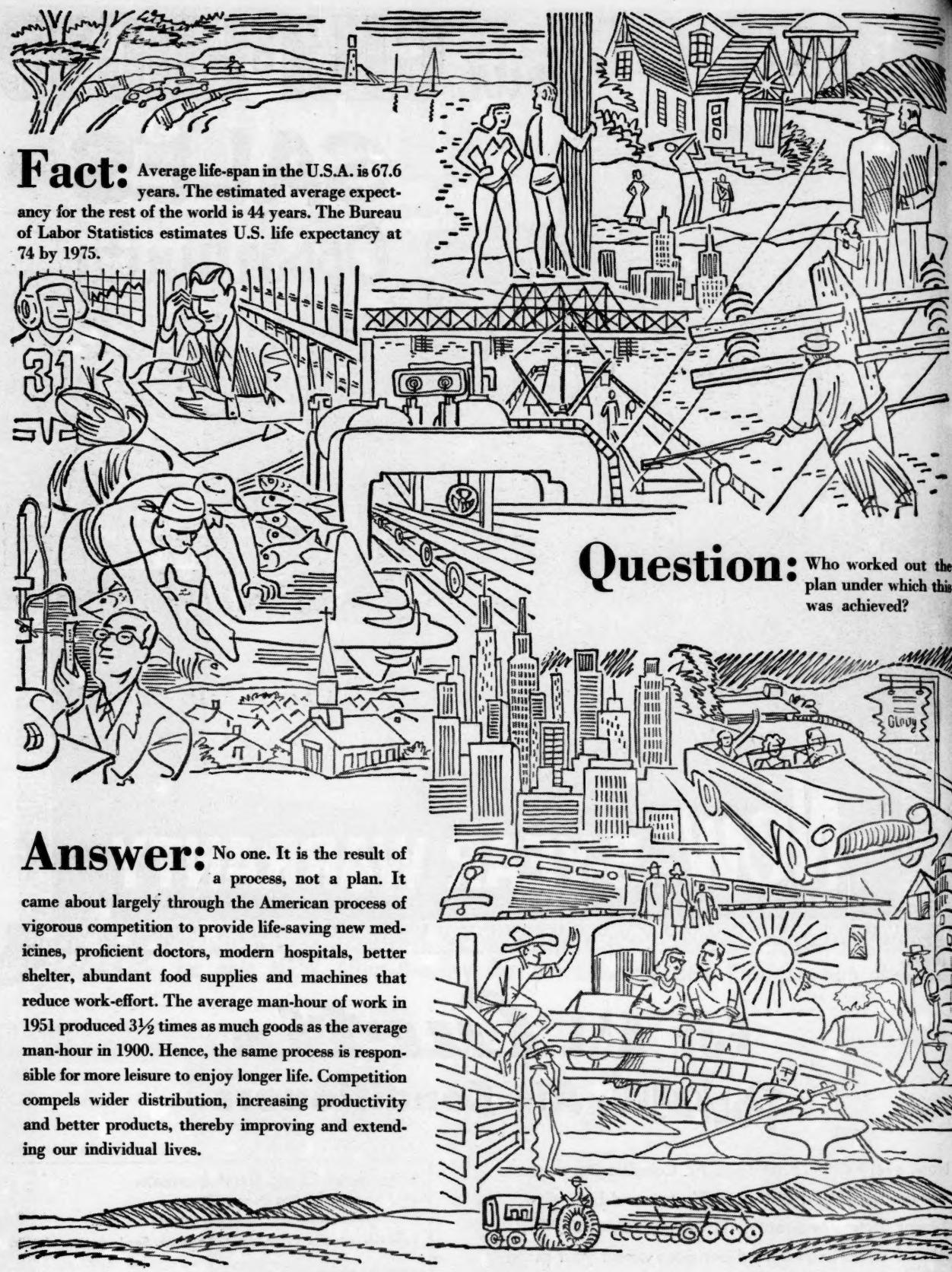
CURTIS REFRIGERATING MACHINE DIVISION
of Curtis Manufacturing Company
1999 Kienlen Avenue, St. Louis 20, Missouri
I am interested in direct factory franchise. Send complete details.

Company Name.....

Street.....

City.....Zone.....State.....

Signed.....



Fact: Average life-span in the U.S.A. is 67.6 years. The estimated average expectancy for the rest of the world is 44 years. The Bureau of Labor Statistics estimates U.S. life expectancy at 74 by 1975.

Question: Who worked out the plan under which this was achieved?

Answer: No one. It is the result of a process, not a plan. It came about largely through the American process of vigorous competition to provide life-saving new medicines, proficient doctors, modern hospitals, better shelter, abundant food supplies and machines that reduce work-effort. The average man-hour of work in 1951 produced 3½ times as much goods as the average man-hour in 1900. Hence, the same process is responsible for more leisure to enjoy longer life. Competition compels wider distribution, increasing productivity and better products, thereby improving and extending our individual lives.

THIS REPORT ON PROGRESS-FOR-PEOPLE *is published by this magazine in cooperation with National Business Publications, Inc., as a public service. This material may be used, with or without credit, in plant city advertisements, employee publications, house organs, speeches, or in any other manner.*

THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE

CLIMATE DICTATED THIS HOUSE

Now You Can Dictate the Climate With YORK RESIDENTIAL AIR CONDITIONING

Only YORK Gives You All 8

- **Faster Cooling!** Unique Cooling Maze Coil cools and dehumidifies faster.
- **Better Heat-Humidity Balance!** Step-Matic Control dehumidifies without overcooling.
- **Lowest Maintenance Costs!** Completely Hermetically Sealed Refrigerating System is trouble-proof.
- **Lowest Operating Costs!** Capillary tube refrigerant feed, plus step-starting relay, reduces York's starting current requirements.
- **Lower Installation Costs!** Adaptable to any heating system.
- **Lower Cleaning Costs!** Two heavy filters comb dirt, dust, soot, pollen from the air.
- **Quieter Operation!** Built-in compressor mufflers, cushion mountings and acoustically treated cabinet reduce operating sound to a minimum.
- **York's Five Year Protection Plan!** Your assurance of trouble-proof performance.

York Residential Air Conditioning frees you, the architect, from the restrictions of "hot-weather planning."

From the moment you include York in your plans you've solved the problems of heat, humidity, circulation, ventilation and dust in the designing and building of homes, whatever their type and size.

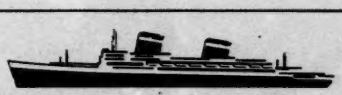
York manufactures seven Residential Air Conditioners. They are designed to condition entire houses—compact, central installations. They may be placed wherever you find it most convenient—in the attic or service closet, in the garage or basement. And only York gives you complete freedom in your choice of heating plant—you can choose any make and any type, whether it be forced warm air, gas-fired steam, coal-steam, oil-fired hot water.

You need not worry, either, over time-consuming installation details . . . a York system is easily installed, and an experienced York engineer will be glad to assist you in planning.

Call your nearby York Representative today—he's listed in your Classified Telephone Directory. Or write to York Corporation, York, Pennsylvania.

THE BIG ADVANCES COME FROM

YORK



The great new Superliner, S. S. UNITED STATES, has York Air Conditioning and complete Refrigeration for ships' stores and cargo space!

HEADQUARTERS FOR MECHANICAL COOLING . . . SINCE 1885

THE PICK OF THE PACKERS

Out where the West *ends* . . . many of the great meat packers use Worthington *refrigeration* machinery.

And all over the country, many famous *restaurants*—Toffenetti's in Times Square, Silver Fox Restaurant in Washington, The Century Room, Dallas—use Worthington *air conditioning machinery*.

When you specify "Worthington", you specify the air conditioning and refrigeration equipment that's used by the "first" names in every field.

No other manufacturer makes so *complete* a line. A Worthington system is all Worthington-*made*—not just Worthington-assembled—assuring you of perfectly balanced operation and unit responsibility.

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, New Jersey.

America's Leader's... in Many Businesses... Select

WORTHINGTON

A-2.11

AIR CONDITIONING AND REFRIGERATION

The Most Complete Line... Always the Correct Recommendation

LADISH

Controlled Quality

PIPE FITTINGS

maximum service assured by metallurgical soundness

Sound metallurgy . . . the result of unsurpassed facilities and advanced laboratory controls . . . provides the maximum of dependability in Ladish Controlled Quality fittings. Every phase of metal quality . . . composition, structure and physical properties . . . is continuously safeguarded—and certified proof of metallurgical integrity is available to users of Ladish fittings.

TO MARK PROGRESS

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

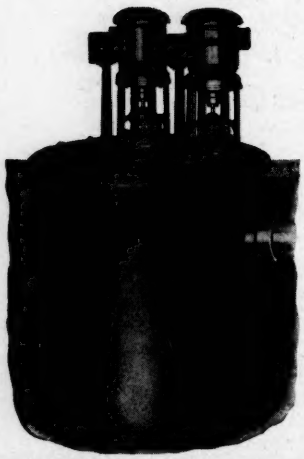
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • Havana • Toronto • Mexico City

weil *Condensate Pumps*

ENGINEERED TO SOLVE YOUR PROBLEMS

Specify the pumps engineered to do the best job! There is a **weil** pump for every heating problem and unusual condition. Ratings, receiver capacities and performance of **weil** pumps meet ASHVE standards.

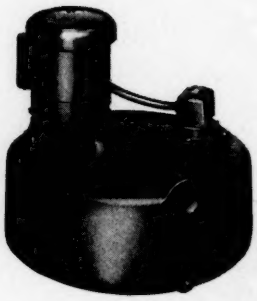


FOR UNDERGROUND INSTALLATIONS

NRG

Requires minimum space.

Send for
BULLETIN NRG 200-C
Tells you when to use and how to efficiently install an underground condensate pump.



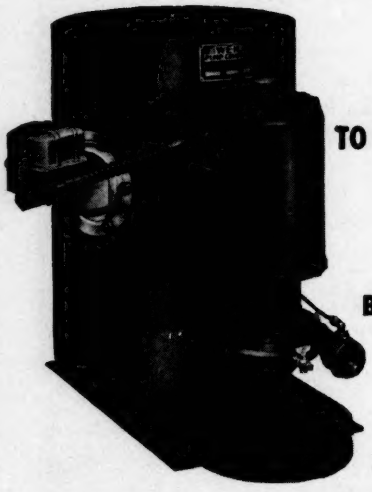
FOR LOW PRESSURE SYSTEMS

TVC

LOW RETURN
CAST IRON RECEIVER
Capacities to 10000 EDR
Send for
BULLETIN TVC 300-B

Available from Jobbers' Stocks
TVC-29—2000 Sq. Ft. E.D.R., 20# P.S.I.
TVC-35—4000 Sq. Ft. E.D.R., 20# P.S.I.

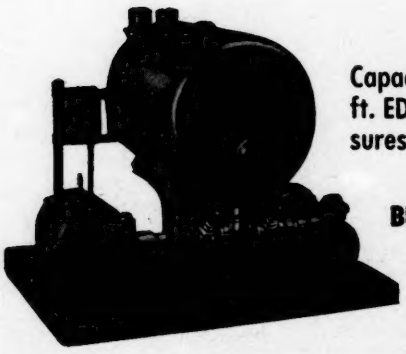
SEND FOR DESCRIPTIVE BULLETINS INTELLIGENTLY DESIGNED TO MAKE PUMP SELECTIONS AND INSTALLATIONS SIMPLE AND EFFICIENT



FOR CAPACITIES TO 50000 SQ. FT. EDR

SRC

Send for
BULLETIN SRC 450



FOR HIGH AND LOW PRESSURE SYSTEMS

TR

Capacities to 150,000 sq. ft. EDR and discharge pressures to 125 lbs.

Send for
BULLETIN TR 100-D

THE EFFICIENCY OF YOUR HEATING PLANT IS DEPENDENT UPON EFFICIENCY AND DEPENDABILITY OF YOUR CONDENSATE RETURN PUMP

weil PUMP CO.

1530 N. FREMONT ST. CHICAGO 22, ILL.

weil *Dependable* PUMPS

IN SWEET'S
1951-1952

efficiently designed for sidewall and baseboard installations

The Standforated sidewall registers have horizontal bendable bars, set at time of fabrication for 30 degree downward deflection. Each bar can be easily readjusted with a tool to any angle for upward, downward or straight flow. No. 41H SIDEWALL REGISTER has a single damper and 3/16" turned down edge for flush sidewall installation. Sponge rubber gaskets are attached. No. 43H BASEBOARD REGISTER has a single damper and 7/8" projection top and two ends, for baseboard installation. Also available as: No. 42H BASEBOARD INTAKE and NO. 40H SIDEWALL GRILLE. Prime coat or metallic finish—standard screw holes. Over-all of face is listed duct dimension plus 1 3/16".

DUCT SIZE
8" x 4"
8" x 5"
*8" x 6"
10" x 4"
10" x 5"
*10" x 6"
10" x 8"
12" x 4"
12" x 5"
*12" x 6"
12" x 8"
14" x 4"
14" x 5"
*14" x 6"
14" x 8"
24" x 4"
24" x 5"
24" x 6"
24" x 8"
30" x 4"
30" x 5"
30" x 6"
30" x 8"

*stock items

Registers are visible symbols of comfort. On your jobs, you want the best to show . . . so, to be *sure*, use Standard Stamping's Registers and Grilles. All Standard registers are engineered for accurate and easy operation. Illustrated above is model No. 41H Sidewall Register. The side view shows one of the *two damper tension screws* that are adjustable to meet your operational requirements. The tension screws are set at the factory for positive operation. On the damper control lever is Standard's new **FRACTIONATOR VOLUME CONTROL.** This amazing new device allows you to set the damper for optimum volume in balancing your heating system, and maintain that balance permanently.

MAIL COUPON NOW FOR MORE INFORMATION, FREE!

STANDARD STAMPING & PERFORATING CO.,
3129 West 49th Place, Chicago 32, Illinois
Gentlemen:
Please send me a copy of your new Pocket Catalog, at no obligation to me.
Name_____
Company Name_____
Address_____
City_____ Zone____ State_____

Standard Stamping & Perforating Co.

3129 W. 49TH PLACE, CHICAGO 32, ILLINOIS

FIELD REPORT

...actual quotations reporting on Electromaze installation at National Schools, Los Angeles, Cal.

CUSTOMER'S REPORT: *"Electromaze has given satisfactory service for over two years, has approval of Los Angeles Air Pollution Control Board", says G. A. Applegate, Chief Instructor, National Schools.*

CONTRACTOR'S REPORT: *"Electromaze solved a tough air pollution problem, proved to be an entirely satisfactory installation", says V. W. Sharpe, Sharpe Engineering Co.*

EXHAUST SMOKE from diesel engines used by students of National Schools, Los Angeles, Cal., was causing neighbors to complain about the damage being done to their buildings and cars—was adding to the city's smog problem.

Cooperating with the Air Pollution Control Board, the school studied the problem and decided that an Electromaze electrostatic dirt precipitator would be the most practical and economical solution.

After two years of service, both the customer and contractor report that the Electromaze proved to be highly efficient and dependable in removing the major portion of the carbon and oil particles from the smoke.

Electromaze is made up of individual cells that slide in and out like filing cabinet drawers. The steel frames come in pre-fabricated sections. You can save up to 50% on installation time because all you do is bolt the sections together. Cleaning Electromaze is quick and easy—right in place, or by removing the cells. For more information, ask your consulting engineer about Electromaze or contact your nearby Air-Maze representative. Air-Maze Corp., Cleveland 5, Ohio.

AIR FILTERS
SILENCERS
SPARK ARRESTERS

AIR-MAZE

THE FILTER ENGINEERS

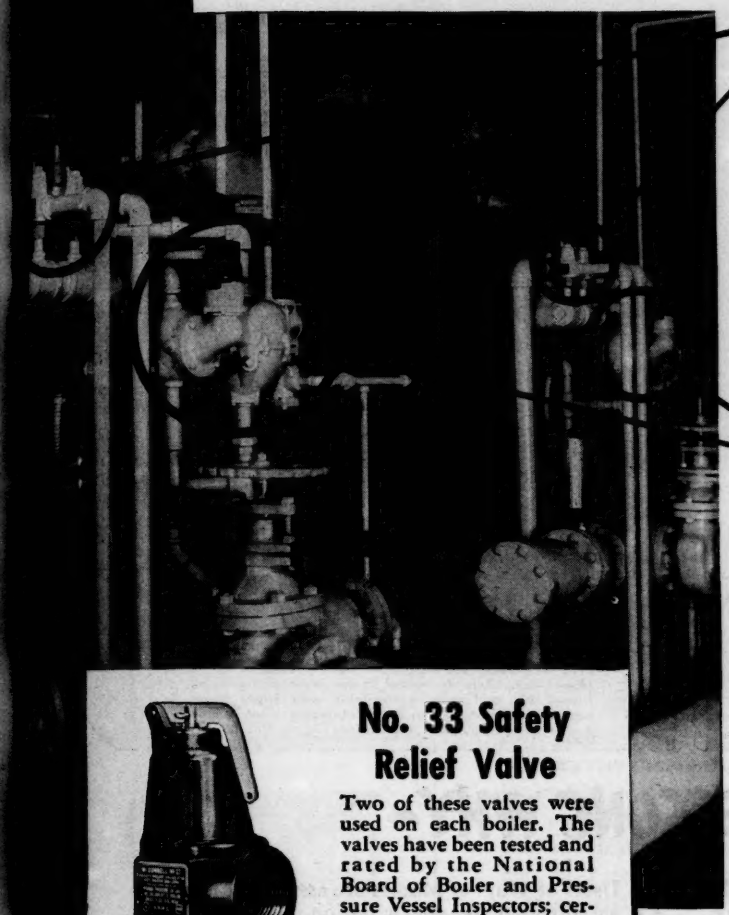
LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

On any well-dressed job—

A contractor wrote us recently that he considered a boiler undressed if it wasn't equipped with McDonnell safety devices. A few days later the photo below came in as if planned to illustrate what a particularly well dressed boiler wears.

This hot water heating plant is in a Los Angeles garage and office building. It was designed by an engineer who knows his equipment thoroughly.

Let's see what he has here:



1 Two McDonnell No. 33 Series Safety Relief Valves on each boiler

The first thing to do in the interest of safety was to provide *adequate* pressure relief. This, under the ASME Boiler Code, means pressure relief of adequate volume to dissipate the total gross Btu. output of the boiler. To comply with this the engineer has chosen the McDonnell No. 33 Series ASME labelled, Btu.-rated relief valve for his 30 lb. valves supplemented by a larger capacity 45 lb. steam valve. All authorities now agree that this is the one sure way to prevent over-pressure under all conditions.

2 A No. 247 Boiler Water Feeder and a No. 63 Low Water cut-off teamed up on each boiler

Sounds like steam-boiler protection, doesn't it? But it's not: the engineer was not content merely to safeguard these boilers from over-pressure. He also knew that prolonged discharge of ample-capacity pressure relief valves could cause a rapid drop in the boiler water level with attendant problems. To guard against this he has equipped each boiler with a McDonnell No. 247 Boiler Water Feeder and a McDonnell No. 63 Low Water Cut-off.

McDonnell boiler water feeders can be selected to match the size of the boiler to prevent low water under any condition except the most extreme emergency. But even the extreme condition is provided for by the No. 63 Low Water Cut-off — especially designed for hot water boilers. The cut-off is positioned to stop the burner if the boiler water level drops 1½ inches below the opening level of the No. 247 feeder.

Yes, every precaution has been taken here to protect this plant. It is an excellent example of boiler safety the McDonnell way — the kind of precaution that should be taken with every hot water steam boiler from the smallest to the largest.

Ask for catalog covering McDonnell boiler safety devices.

McDONNELL & MILLER, INC.
3500 N. Spaulding Ave., Chicago 18, Ill.

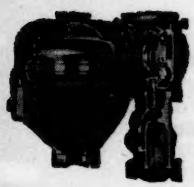
Your Jobber Stocks Them

Doing One Thing Well

McDONNELL
Boiler Safety Devices

No. 33 Safety Relief Valve

Two of these valves were used on each boiler. The valves have been tested and rated by the National Board of Boiler and Pressure Vessel Inspectors; certified ratings of 242,900 Btu./hr. and symbol of ASME compliance appear on the label.



No. 247 Boiler Water Feeder

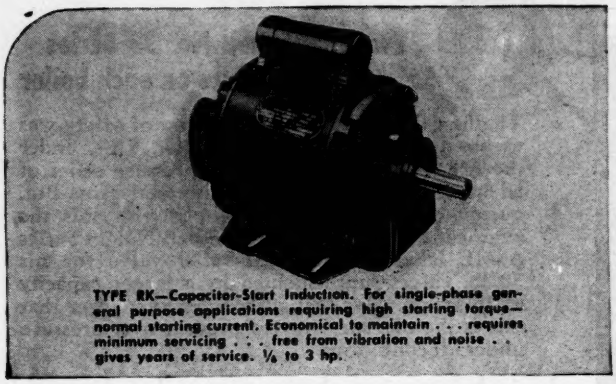
This is teamed with the No. 63 Low Water Fuel Cut-off on each boiler.

No. 63 Low Water Fuel Cut-Off

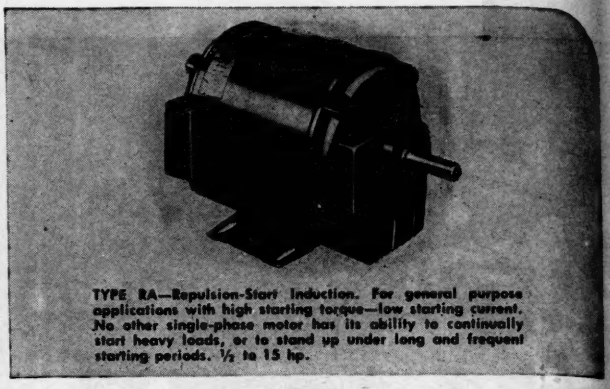
This cut-off, especially built for hot water boilers, is teamed with the No. 247 feeder.

Wagner
ELECTRIC MOTORS
...the choice of leaders in industry

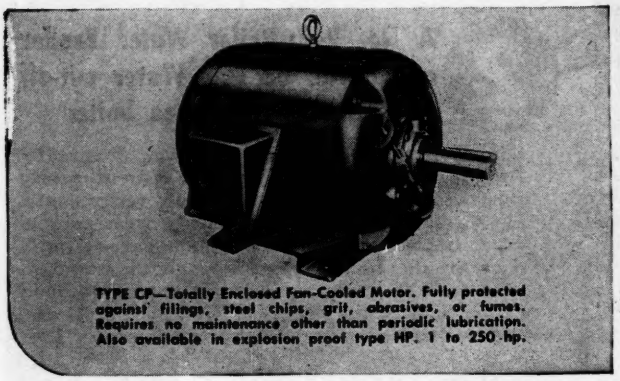
If dependable motor performance is a "must" for your product... specify Wagner



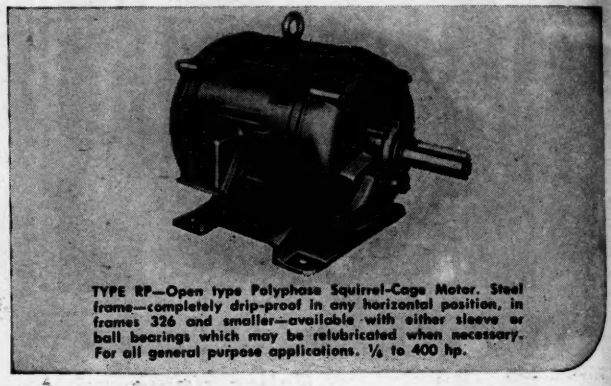
TYPE RK—Capacitor-Start Induction. For single-phase general purpose applications requiring high starting torque—normal starting current. Economical to maintain . . . requires minimum servicing . . . free from vibration and noise . . . gives years of service. ⅛ to 3 hp.



TYPE RA—Repulsion-Start Induction. For general purpose applications with high starting torque—low starting current. No other single-phase motor has its ability to continually start heavy loads, or to stand up under long and frequent starting periods. ½ to 15 hp.



TYPE CP—Totally Enclosed Fan-Cooled Motor. Fully protected against fillings, steel chips, grit, abrasives, or fumes. Requires no maintenance other than periodic lubrication. Also available in explosion proof type HP. 1 to 250 hp.



TYPE RP—Open type Polyphase Squirrel-Cage Motor. Steel frame—completely drip-proof in any horizontal position, in frames 326 and smaller—available with either sleeve or ball bearings which may be relubricated when necessary. For all general purpose applications. ⅛ to 400 hp.

4 GOOD REASONS WHY-

1. Wagner Motors, for over sixty years, have established unexcelled records for continuous, troublefree performance.

2. Wagner Motors are well-known for their superior quality and their sturdy design and construction.

3. The many types of motors and motor modifications in the standard Wagner line helps the designing engineer in his selection of the right motor for the job.

4. Users of Wagner Motors are assured of fast service through Wagner's nation-wide service organization of 26 Wagner-owned Service Branch Warehouses and more than 650 Authorized Service Stations which provide on-the-spot service, replacement motors, or genuine Wagner motor repair parts.

The wide range of types and sizes of Wagner motors permits the selection of a trim, compact standard motor to meet your definite needs. Bulletin MU-185 gives full information on the complete line. Write for your copy.

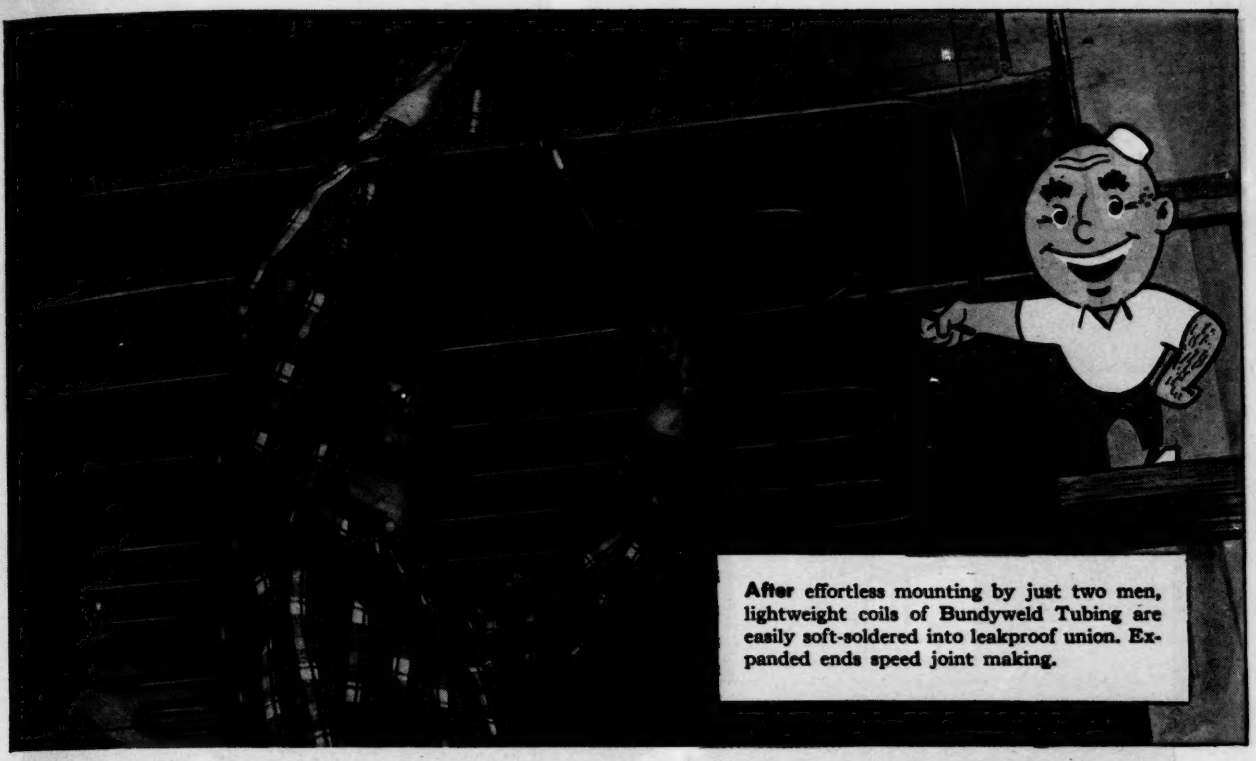
WAGNER ELECTRIC CORPORATION
6463 Plymouth Ave., St. Louis 14, Mo., U.S.A.

®Wagner Electric Corporation
EST. WE 1891

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

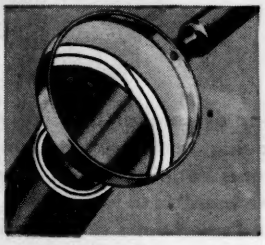
BRANCHES IN 32 PRINCIPAL CITIES

M52-15



After effortless mounting by just two men, lightweight coils of Bundyweld Tubing are easily soft-soldered into leakproof union. Expanded ends speed joint making.

Be first in your locality with the newest — Bundyweld Ceiling Radiant Heating



Key to Low Cost

Bundyweld is the only tubing double-walled from a single strip. It's steel, copper-coated inside and out. It gives finest radiant heating performance, with savings up to 50% on material costs and installation time.

Standard 20′ or 24′ lengths of Bundyweld are easily formed into coils in shop or on job site. Expanded ends (furnished when specified) are quickly soldered into leakproof union. Joined, lightweight coils are easily mounted onto ceiling, quickly plastered over.

Beat your competitors to the punch!

Every day more builders and plumbing and heating contractors are putting the emphasis on Bundyweld Ceiling Radiant Heating—today's fastest-growing, most practical heating method.

More and more prospective home buyers and home builders are inquiring with eager interest about such features as lower operating costs, healthfully moderate air temperatures, absence of dirt-catching radiators and registers, streak-free walls and ceilings, unlimited choice of flooring materials.

Proof? Bundy ads in *Better Homes & Gardens* and *American Home* bring coupons from thousands of people wanting the full story on Bundyweld Ceiling Radiant Heating *plus* the names of builders and plumbing and heating contractors installing it.

Send coupon today for details on Bundyweld Ceiling Radiant Heating and Bundyweld Tubing.

Radiant Heating Division

BUNDY TUBING COMPANY

Detroit 14, Michigan

SEND TODAY! FREE!

LIKE HAVING THE SUN IN YOUR CEILING

Bundyweld Ceiling Radiant Heating

Radiant Heating Division, Dept. HV-852
Bundy Tubing Company, Detroit 14, Michigan

☐ Send free 20-page nontechnical brochure explaining Bundyweld Ceiling Radiant Heating.
☐ Send Bundy technical radiant heating pamphlet.

Name_____ Title_____

Company_____

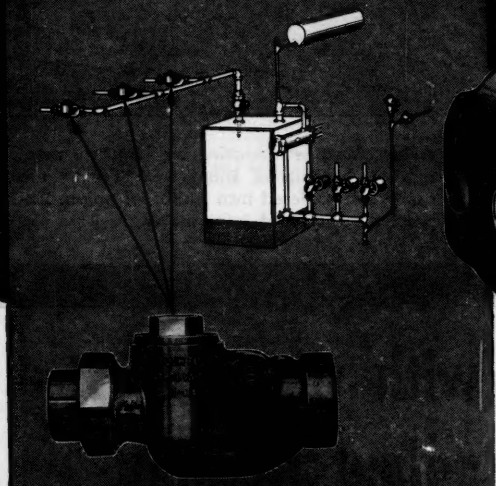
Address_____

City_____ Zone____ State_____

New Units for '52

HELP YOU PROVIDE BETTER HOT WATER HEAT

more conveniently and economically



3 NEW SIZES Thrush Water Circulators

Low volume horizontal units for small heating plants. 3/4", 1", and 1 1/4" sizes.

AN INCREASING number of smaller hot water heating systems are now being installed. The low water content of these systems requires small, low capacity circulators if "volume hum" is to be avoided. These new competitively priced small units enable you to do a better job at lower cost. Powered with 1/6 horsepower motors, with the same mechanical construction of the larger Thrush Circulators, and built-in lubrication, they will run quietly and smoothly for years. For information on the complete Thrush Flow Control System and other time-saving, money-saving hot water heating specialties, see your wholesaler or write Dept. D-8.

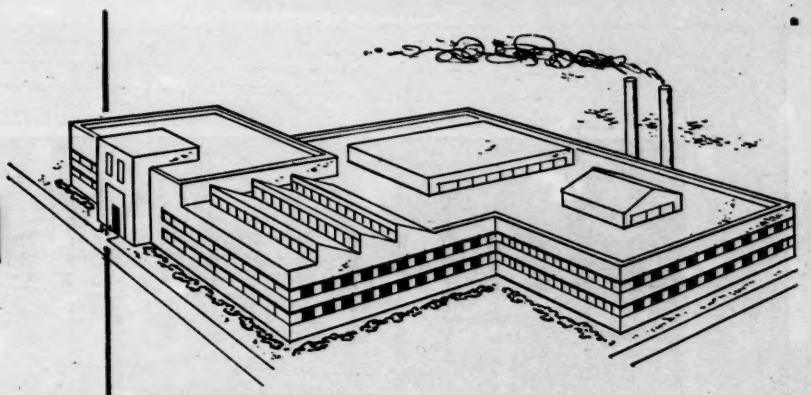
H. A. THRUSH & COMPANY
PERU • INDIANA

THRUSH

FOR [illegible] OW CONTROL HOT WATER HEAT

Large area heating...

WITH OR WITHOUT DUCT-WORK

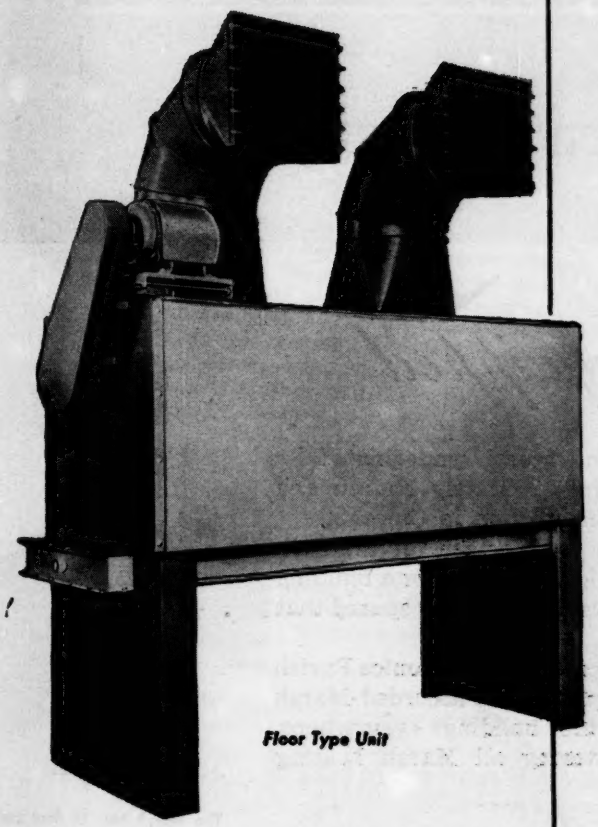


McQuay

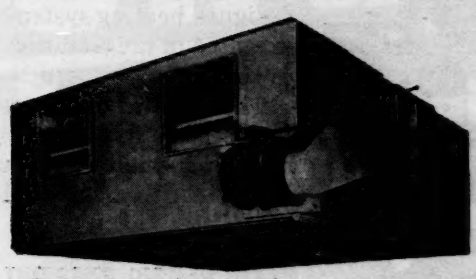
BLOWER-TYPE

Unit Heaters

Where heat must be diffused over large open areas, as in warehouses, garages and industrial plants, the McQuay Blower-Type Unit Heater has a wide application. Available in floor, horizontal, vertical, wall and inverted styles in 8 sizes, up to 1,600,000 Btu. Only McQuay can give you famous Ripple-Fin coils—the construction feature that assures maximum heat transfer efficiency. Representatives in principal cities. Write McQuay Inc., 1619 Broadway Street N.E., Minneapolis 13, Minnesota.



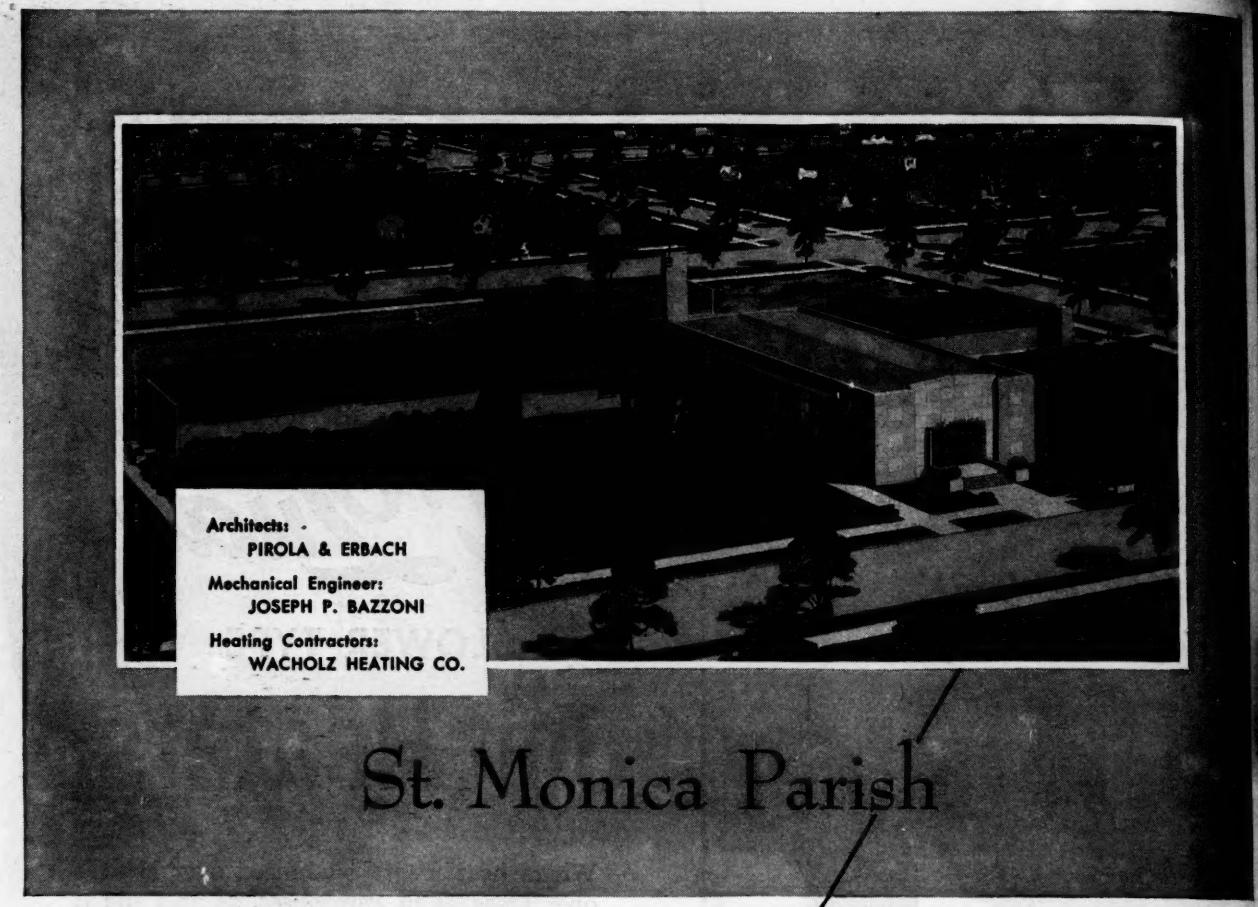
Floor Type Unit



Horizontal Unit

McQuay INC.

HEATING
AIR CONDITIONING
REFRIGERATION



Architects:
PIROLA & ERBACH
Mechanical Engineer:
JOSEPH P. BAZZONI
Heating Contractors:
WACHOLZ HEATING CO.

St. Monica Parish

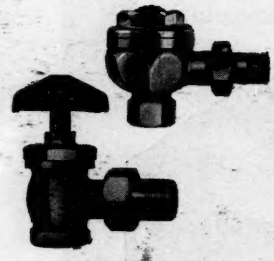
Marsh equipped

Reproduced above is an architectural rendering of St. Monica Parish which combines a stately church and modern school now nearing completion in Chicago.

Marsh Valves and Traps were specified for the well-designed heating system — a logical choice for a building executed in the tradition in which no effort is spared that can contribute to permanence.

The selection of Marsh equipment for St. Monica Parish is one more example of the preference accorded Marsh heating specialties for important buildings everywhere.

Ask for catalog 76-H covering all Marsh heating specialties.



Marsh Packless Radiator Valves and Marsh Thermostatic Radiator Traps were used throughout the St. Monica heating system.

The Marsh No. 12 float and thermostatic trap is typical of many Marsh traps used in the St. Monica installation.

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*

Dept. U., Skokie, Ill.

MARSH

Heating Specialties Since 1865

GAUGES • THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES

Now ... a *field* BAROMETRIC DRAFT CONTROL FOR COMMERCIAL & INDUSTRIAL

GAS FIRED HEATING PLANTS

GATE OPENS OUTWARD

(Not yet available in domestic sizes)

The Field "M-G" Double Acting Draft Control brings greater efficiency, greater economy to gas fired heating plants through extremely accurate control of drafts. The double-acting gate opens inward to regulate up-drafts, and outward to relieve internal or down-draft pressures as small as a ... of an inch. This newest Field Draft Control ... heating plants the same accuracy, sensitiv... have made Field Draft Controls first in... Write today for detailed specifications.

FIELD CONTROL
of H. D. Conkey & Company, ME...

SEE OUR DIS...
OIL HEAT INSTITUTE ...

In case of pressure ... thermal ventilator ... and wired to ... against the escape of ...

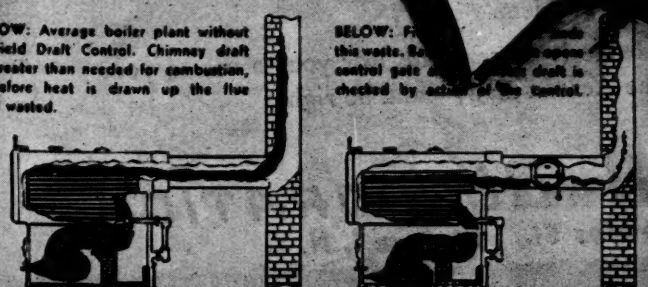
OK'd by America's Leading Gas Companies

and many City Safety Inspectors

Why a Field Dra...

BELOW: Average boiler plant without a Field Draft Control. Chimney draft is greater than needed for combustion, therefore heat is drawn up the flue and wasted.

BELOW: Fi... this waste. Ba... control gate ... checked by ... control.



CONTROLLED DRAFT BY *field* BAROMETRIC CONTROLS

Field Control Division, of H. D. Conkey & Company, Mendota, Ill.

ASK THE AEROFIN MAN

For the Practical Answer to Your Heat-Exchange Problem . . .

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

There is a competent Aerofin heat-transfer engineer near you, qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem.

This specialized knowledge is there, ready for you to use to your greatest advantage. Ask the Aerofin man — and be right.

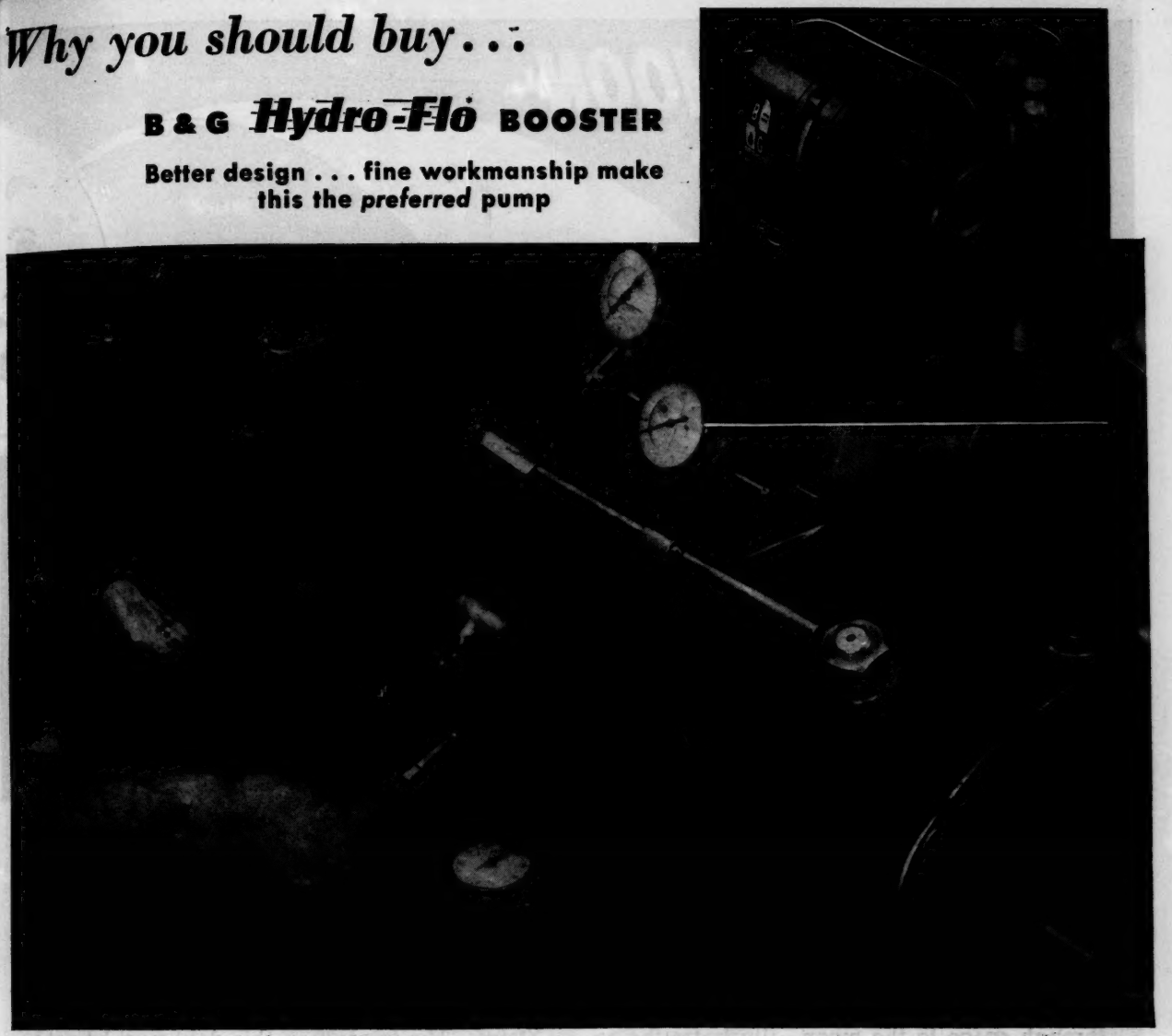
AEROFIN CORPORATION

410 South Geddes St., Syracuse 1, N. Y.

Why you should buy . . .

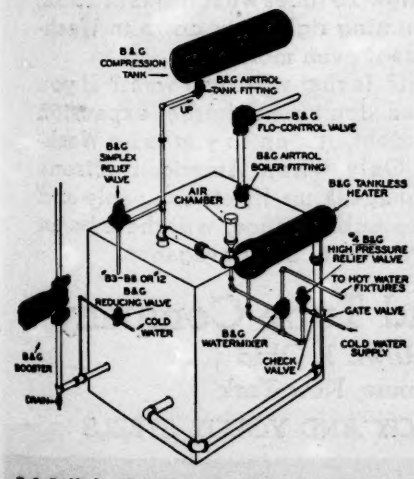
B & G Hydro-Flo* BOOSTER

Better design . . . fine workmanship make this the *preferred* pump



*Reg. U. S. Pat. Off

Precise to .0005 of an inch



Here you see one of the reasons *why more B & G Boosters are sold than all other circulators combined!*

You are looking at the final finishing operation in producing Booster pump shafts. All shaft dimensions are maintained within .0005 inch limits with these extremely accurate grinders. Note the micro-gauges. One indicates the surface flatness of the thrust collar, one the diameter of the shaft and the third is used to position the work in the machine. When finished, Booster pump shafts are mirror smooth and exactly uniform!

All Booster parts are made with similar attention to the quality of workmanship. That's why B & G Boosters are setting records for long, *quiet* and dependable performance. Thousands have been in operation for many years *without need for service of any kind!*

B & G *Hydro-Flo* Products offer everything you need for forced hot water heating systems and domestic water heating. Look for the B & G label—symbol of quality.

BELL & GOSSETT
COMPANY
Dept. CP-4, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

On a road paved with YOUR Dollars

A road twenty feet wide, carpeted with one dollar bills, extending 256,471 miles through space to the moon,--illustrates the astronomical magnitude of our Federal debt.

1932 was a bad year for most of us, whether we were in business, or looking for a job, or going to school.

1952 seems much better to the majority of our citizens, with increased business, high wages and a good education for the children.

But how much better off, really, are those of us who think "we're in clover"? Consider our National debt which has skyrocketed from 19 billion dollars to over 260 billion dollars in the past twenty years.

Such a figure is difficult to grasp. But it represents your debt, the amount that you and your family must pay. This debt is the obligation of every man, woman and child in the United States. The interest on this debt must be paid through taxes, and as the debt increases, the more our taxes will increase. If you have a wife and two children, your share of the Federal debt is now approximately $7,000.

Your debt is now 13 times what it was in 1932, and they're planning right now, down in Washington, to inflate it even more.

Do you like it? Is that what you want? If you don't like it and don't want further expansion of our Federal debt, it's up to you to let Washington know. Only when American citizens are aroused and speak up, by electing able and patriotic men to public office, will there be an end to this orgy of public extravagance.

YOUR SCRAP IS NEEDED — YOUNGSTOWN

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.

Whatever the job you're right with a **DELCO!**

Whether you need totally enclosed or open-end motors . . . fan cooled or explosion-resistant motors . . . you're certain to get the right motors on the job when you choose Delco.

Each and every Delco motor is designed and built for the job it has to do. It's *made* of the finest materials, and *engineered* to stand up longer under the roughest conditions.

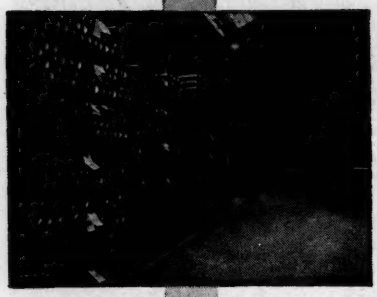
So check up on Delco motors, now. You'll find Delco has the motors you need, and that Delco always meets its commitments. For full details, write to Delco Products, Dayton, Ohio, or call the nearest sales office listed below.

DELCO FEATURES MAKE DELCO FINEST

DELCO
DAYTON OHIO

DELCO PRODUCTS
Division of General Motors Corporation
Dayton, Ohio

HOW DO YOU CHOOSE BETTER BOILER TUBES?



All boiler tubes are made to the same specifications to do the same jobs, no matter what mill supplies them. In the warehouse, they all look pretty much the same. Surface comparison rarely shows the difference. That is because only *time* can truly test the worthiness of a tube in a boiler—time and the ravages of heat, corrosion and oxidation. Look for the answer down in the basements of apartment houses, or hospitals, or schools, or office buildings, or anywhere else you'd expect to find good boilers, made by fine craftsmen, performing efficient and faithful service over the years. Almost anywhere you look, you'll find the most reliable boilers are equipped with B&W boiler tubes.

Say B&W before you say WELDED BOILER TUBES—for Service-Proved Dependability. For three-quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for pressure requirements. The application of this extensive knowledge and experience results naturally in the production of superior boiler tubes.

B&W dependability is proved by time and endorsed by hundreds of customers who keep coming back for more . . . B&W WELDED BOILER TUBES.

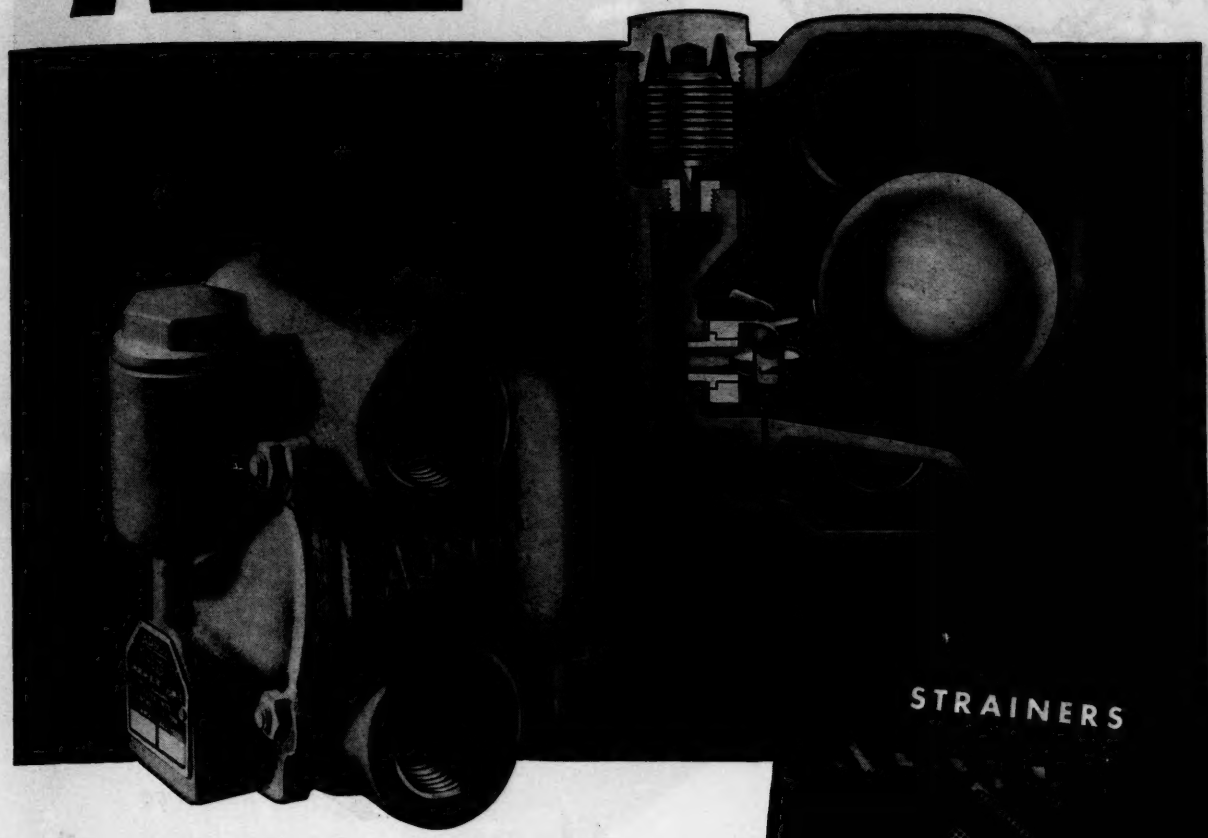
B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION

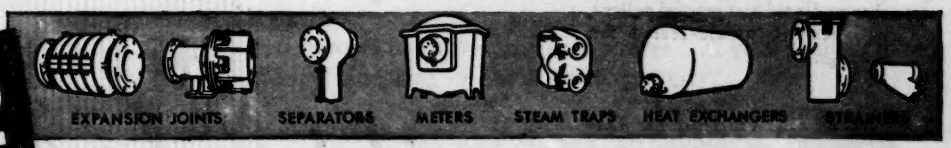
General Offices & Plants
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing
Sales Offices: Beaver Falls, Pa. • Boston 16, Mass. • Chicago 3, Ill. • Cleveland 14, Ohio • Denver 1, Colo. • Detroit 26, Mich. • Houston 19, Texas • Los Angeles 17, Cal. • New York 16, N. Y. • Philadelphia 2, Pa. • St. Louis 1, Mo. • San Francisco 3, Cal. • Syracuse 2, N. Y. • Toronto, Ontario • Tulsa 3, Okla.

TA-1694C

ADSCO DUAL STEAM TRAPS



For low maintenance costs, standardize on ADSCO Dual Steam Traps. ADSCO—and only ADSCO—builds traps with all working parts mounted on the cover. A new cover gives you a new trap. Repair original cover when convenient. Piping connections need not be broken for inspection or servicing. And here's another great feature: valve and seat are reversible, giving double life, double economy. For immediate service, phone your ADSCO Representative today. Shipment will be made from ample factory stocks.



ADSCO
75 YEARS OF LEADERSHIP

AMERICAN DISTRICT STEAM COMPANY, INC.
NORTH TONAWANDA, NEW YORK

WITH HM

COOLING TOWERS

20-Year Guarantee!

ON THE WETTED DECK SURFACE

BATTLESHIP STRENGTH!

HOUSING—
Of heavy 10 gauge (⅛"+) sheet steel, with three coats of Bitumastic lining, and four coats of outside special weatherproof paint. Electrically welded cabinet.

FAN & DRIVE—
Quiet hi-pressure 8-bladed Stainless Steel fan, stainless steel shaft, chrome-dipped rust-proofed pulleys, ball-bearing grease-sealed fan bearings.

Capacity range: 5 Thru 50 Tons

CARRIED IN STOCK BY LEADING WHOLESALERS EVERYWHERE

Send for Literature and Prices

Here's the economy way to water savings—20 years of foolproof performance in an all-around, efficient, economical and lastworthy cooling tower. The processed wetted deck surface in these quality Halstead & Mitchell cooling towers is chemically treated with special Koppers wood—guaranteed 20 years against rotting, and proofed against fungi growth. Gravity-type distributing pan eliminates extra pumping head required on spray-type towers, and cuts down windage losses due to atomizing of water. And, it's easily cleaned—accessible through inlet air side of tower.

HM Halstead & Mitchell

OFFICES: BESSEMER BUILDING • PITTSBURGH 22, PA.

tt

TUBE-TURN

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Streamline your purchase of welding fittings

Scrappy says, "Aid defense—more scrap today... more steel tomorrow."

Write Dept. B-8 for free booklet listing properties of pipe and welding fitting and flange materials.

JUST AS THE USE of welding fittings streamlines a piping system so does the standardizing on TUBE-TURN Welding Fittings streamline your purchasing operations.

The TUBE-TURN Welding Reducer, both in the concentric type shown here and the eccentric type, is available in a complete range of sizes, wall thicknesses and types of materials. This is another example of how the complete TUBE TURNS' line is designed to meet all your requirements. It covers over 4000 different items. Thus you can simplify ordering and deliveries for any piping job by obtaining all your welding fittings and flanges from one reliable source . . . your TUBE TURNS' Distributor. You'll find one in every principal city.

Be sure you see the double "tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

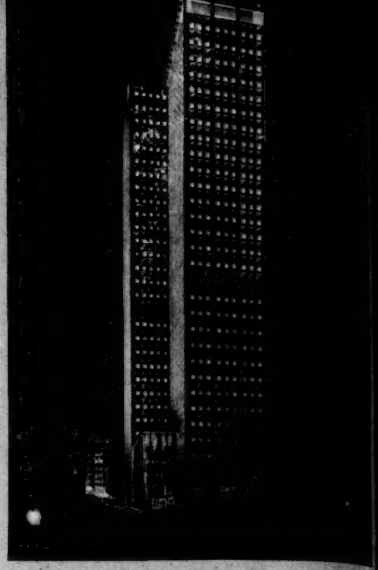
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

30 Stories of New Building Ideas ...includes maintenance-free welded piping

ALUMINUM COMPANY OF AMERICA's new 30-story office building in Pittsburgh is a pacesetter for construction ideas. Exterior walls are made of sheet aluminum. Windows pivot on vertical axes to simplify cleaning. Radiant heating and cooling panels in ceilings increase rentable floor space.

In keeping with this progressive design, a welded piping system, using TUBE-TURN Welding Fittings and Flanges, was specified. Thus piping, both aluminum and steel, will be leak-proof and maintenance-free. The variety of welding-fitting requirements posed no problem, since TUBE TURNS, INC. offers the world's broadest line of welding fittings and flanges—available in a wide range of types, sizes, and more than 40 different metals and alloys.



Alcoa's new office building. Architects: Harrison & Abramovitz. Assoc. Architects: Mitchell & Ritchey and Altenhof & Bown. Heating, Ventilating & Air Conditioning Sub-Contractors: Drave Corp. Plumbing Contractors: Sauer, Inc.

Corrosion-resistant aluminum lines for drinking, and hot and cold water supply saved critical copper. Note how welded lines, from 1" up, are fitted closely together, make for a neat installation. These lines will be insulated.

TUBE-TURN Welding Elbows, Tees, and Reducers used in steel piping for steam and hot water lines in basement. True circularity and uniform wall thickness of TUBE-TURN Welding Fittings expedited installation by insuring accurate fit.

Eight-inch steam line with 2" and 3" branches in fan room on roof. Use of welded system with TUBE-TURN Welding Fittings, simplifies piping design, gives streamlined appearance, eliminates maintenance problems.

TUBE TURNS, INC., Dept. B-8
224 East Broadway, Louisville 1, Kentucky

Your Name .....

Position .....

Company .....

Nature of Business .....

Address .....

City ..... *State* .....

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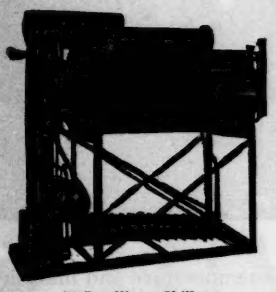
"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC

LOUISVILLE 1, KENTUCKY

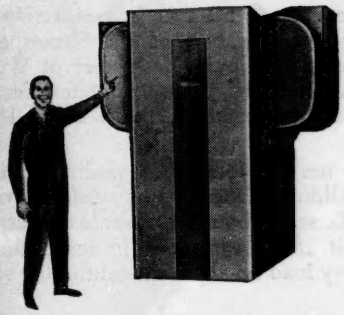
"I like to sell Servel Air Conditioning because it practically services itself."

Only Servel Gives All These Sales-Winning Extras!



25-Ton Water Chiller

Commercial Unit where no ducts are needed



All-Year Air Conditioner

Here's the one Air Conditioning that helps sell itself and helps keep itself *sold!* No other refrigeration unit offers all the Servel features . . . no other unit offers such amazing, trouble-free service. This is the famous equipment that has no compressor . . . no moving parts, no vibration, no noise . . . for minimum maintenance, minimum service on your part. (Refrigerating unit carries a factory guarantee of five full years.) This is the famous equipment that uses *heat* to create *cold*—can be connected to present steam source under any pressure; operates on gas, oil, LP gas, even waste heat! You can select the most economical energy source to keep operating costs low. Refrigerant is water in a pressure-free unit for complete safety. Get the facts today—there is a full range of Servel Air Conditioning Equipment so you can sell every prospect from the residential and small commercial buyer to the large commercial, industrial and military type installation.

SELL SERVEL . . . the air conditioning that offers low operating cost, guaranteed dependability in residential, commercial or industrial installations.

Servel

AIR CONDITIONING

Made by the makers of the famous Servel Refrigerator

SERVEL, INC. • Evansville 20, Indiana

Get the facts and you'll sell Servel! Write for complete information today.

Servel, Inc., Dept. HV-8, Evansville 20, Indiana

Gentlemen: I'm interested in the money-making advantages of selling Servel Air Conditioning Equipment. Send me full details on ☐ Industrial ☐ Commercial Units.

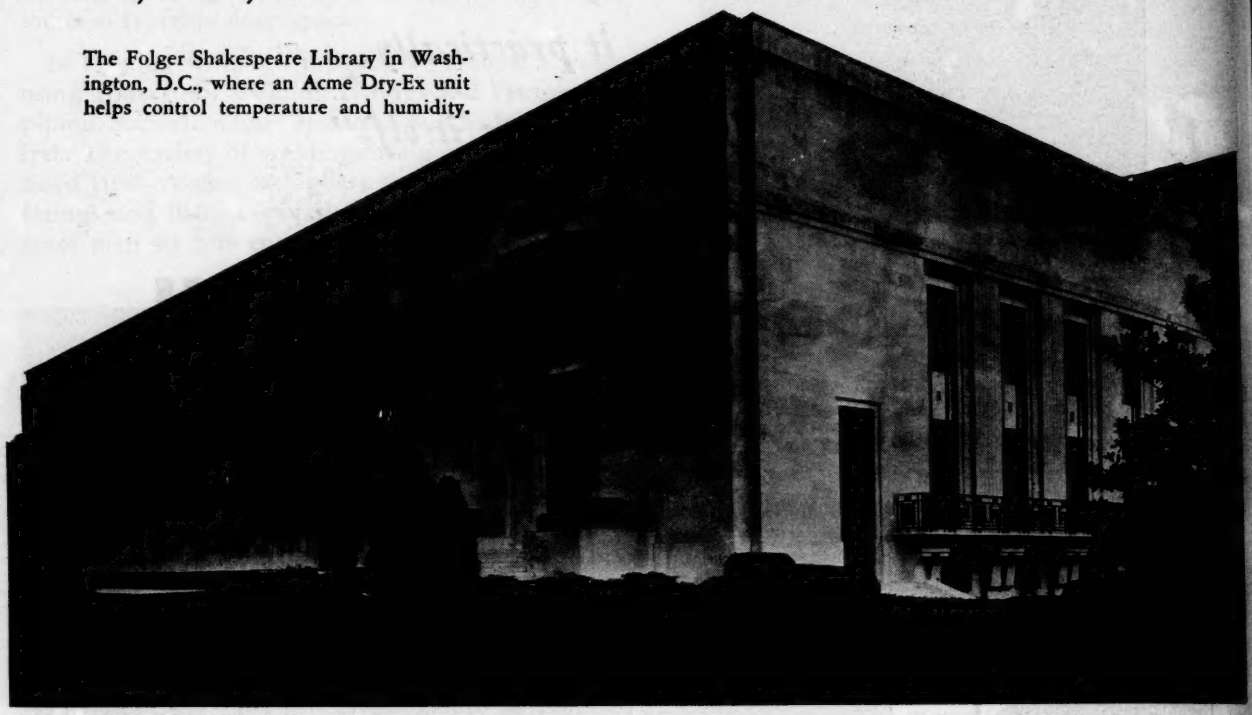
Name.....

Firm.....

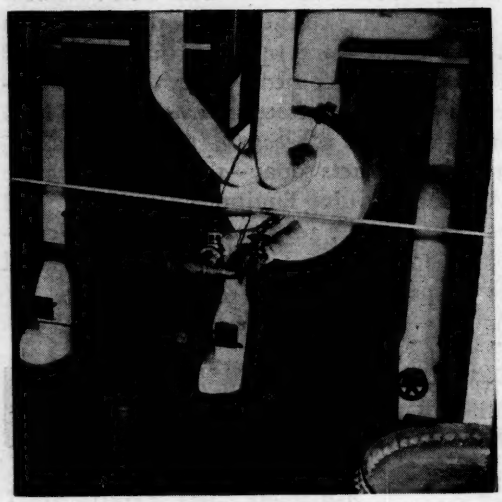
Address.....

City.....*Zone*....*State*.....

Acme DRY-EX CHILLER helps safeguard $10,000,000 SHAKESPEAREAN COLLECTION



The Folger Shakespeare Library in Washington, D.C., where an Acme Dry-Ex unit helps control temperature and humidity.



The Acme Dry-Ex Chiller installed at the Folger Library.

Extremely close year-round control of temperature and humidity is necessary for the protection and preservation of aged parchments and papers. The trustees of the Folger Shakespeare Library in Washington, D. C., recognized this fact in connection with their $10,000,000 collection of literature of the Shakespearean period including 79 of the first folios. The history of Western civilization for the 200 years before 1700 is completely recorded in this collection — one of the greatest in the Western Hemisphere.

The thousands of volumes are located in vaults and rooms spread all over the large building. One room is a full size replica of a 17th century theater. It seats about 200 people and at times has performances held in it. Such variations in space, distance and occupancy placed a heavy load on any air conditioning system installed.

The installation finally decided upon was engineered and designed by the Griffith Consumers Company. It is a 100-ton chilled water air conditioning system that has as one of its component parts a 20" by 14' Acme Dry-Ex Water chiller. This unit was selected for its easy adaptability to variable loads and for its life-long assured, dependable performance.

ACME INDUSTRIES, INC.
FLOW COLD DIVISION
Jackson, Michigan

ACME PRODUCTS

CONTINUOUSLY SERVING THE AIR CONDITIONING AND REFRIGERATION INDUSTRIES SINCE 1919

NOW! Do your construction fastening up to 100 times faster with

NEW CARTRIDGE-POWERED MODEL 450

REMINGTON STUD DRIVER

. . . and do it safely!

This revolutionary tool attaches steel or wood structural pieces to concrete or steel surfaces in seconds . . . cuts costs and working time on construction jobs. Completely self-powered, the Stud Driver sets as high as 5 studs per minute . . . with no outside power source or other equipment required. Studs have pull-out resistance as high as two tons!

Test-proved to be the world's finest and speediest fastening system, the Model 450 Remington Stud Driver is made by Remington Arms Company, Inc., *America's oldest and foremost sporting arms manufacturer*. Price for Model 450, complete in rugged steel carrying case—only $119.50. To obtain detailed information on this time and money-saving tool, and for the name of your nearest distributor, fill out and mail the coupon below.

Speeds all these jobs . . . and many more!

1. Anchoring pipe hangers in concrete.
2. Fastening pipe stanchions in concrete.
3. Hanging instruments to concrete or brick.
4. Anchoring lavatory and laundry fixtures to concrete or steel.
5. Anchoring suspended ceilings, sprinkler systems and lighting fixtures to concrete.
6. Hanging radiator housings to concrete or brick.

"If It's Remington—It's Right!"

Remington DUPONT

Simply hand-assemble stud and power cartridge, load as a unit in easy-to-open Remington Stud Driver, and close.

Press loaded Stud Driver firmly against surface, depress safety lever and pull trigger. Explosive charge imbeds stud solidly.

Remington Arms Company, Inc.
Industrial Sales Division, Dept. HV-8
939 Barnum Ave., Bridgeport 2, Connecticut

I am interested in obtaining detailed information on the Model 450 Remington Stud Driver.

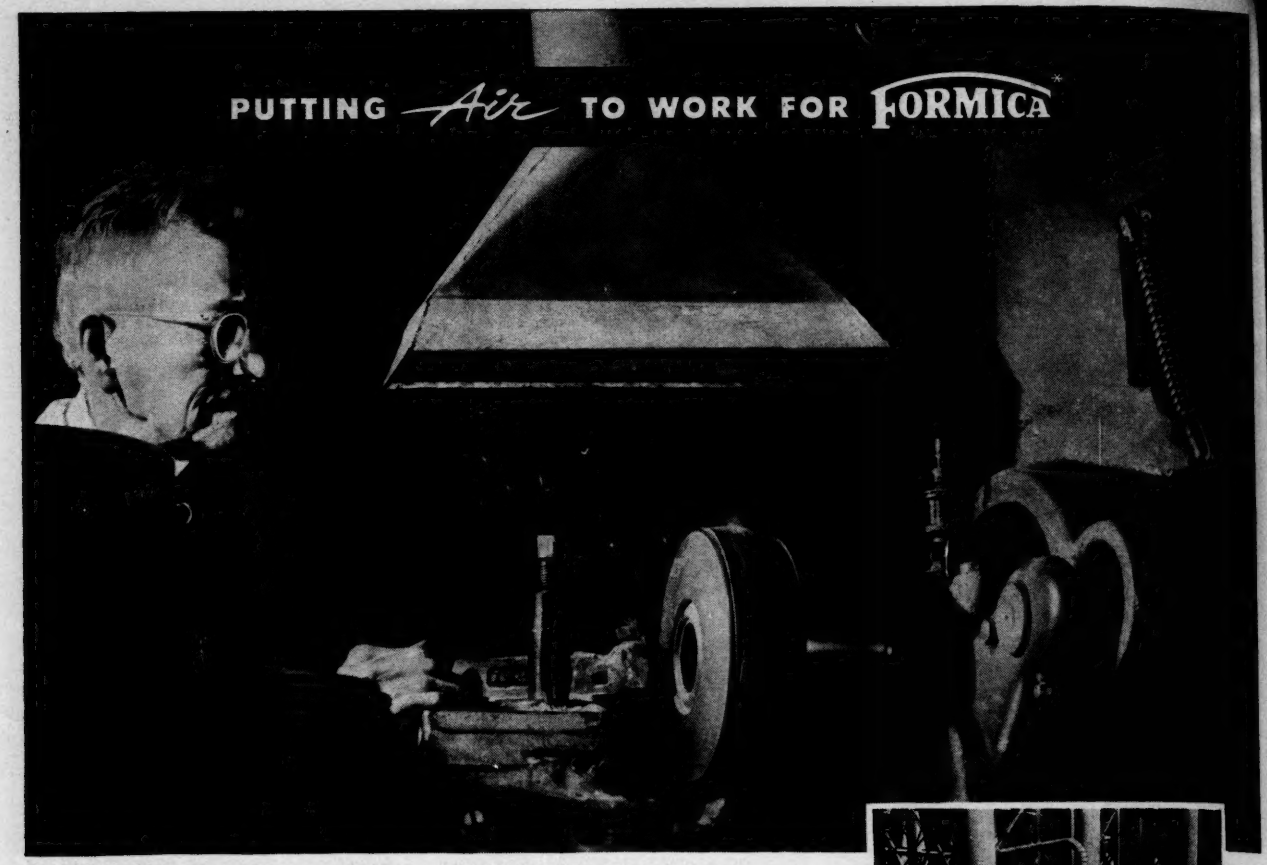
*Name*_____

*Firm*_____

*Position*_____

*Address*_____

*City*_____ *State*_____



On each machine, a powerful stream of air draws tiny dust particles into the collection system before they can be dispersed and become a health or maintenance problem.

HOW TO "DUST OFF"

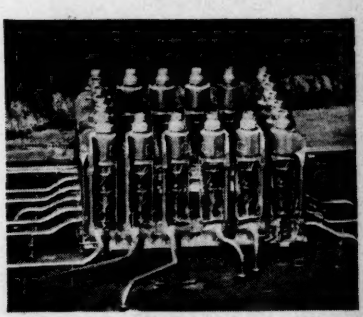
150 MACHINING OPERATIONS AT ONCE

They're literally giving dust "the air" at Formica's new Cincinnati plant. With more than 150 micro-sanding and finishing machines working on decorative sheets or laminated shapes, well over 100 pounds of fine dust are created every hour. Unchecked, it would represent a hazard to worker health and efficiency as well as a costly cleaning and maintenance problem.

The answer? A dust collection system was designed and installed by Kirk & Blum using 32 powerful Westinghouse-Sturtevant fans. Through individual hoods serving each machine, 218,000 cfm of air picks up dust particles and carries them to collectors on the plant roof. Although completely exposed to the elements, expert engineering and rugged construction has given these fans the ability to "take it" and still perform at top efficiency the year 'round.

To help you *put air to work*—with air handling, air conditioning or air cleaning—Westinghouse offers a complete line of industry-proven equipment to meet your individual needs. See the new General Catalog 600, a 60-page reference file, describing the full product line and its industrial applications. To get a free copy, call your local Westinghouse-Sturtevant office, or write Westinghouse Electric Corp., Sturtevant Division, Hyde Park, Boston 36, Mass.

Carefully designed blades in these Westinghouse fans give highest operating efficiencies with lower power consumption.



A 20-collector Kirk & Blum system handles dust particles 100 microns and smaller in size with 99.5% collection efficiency.

YOU CAN BE SURE... IF IT'S Westinghouse

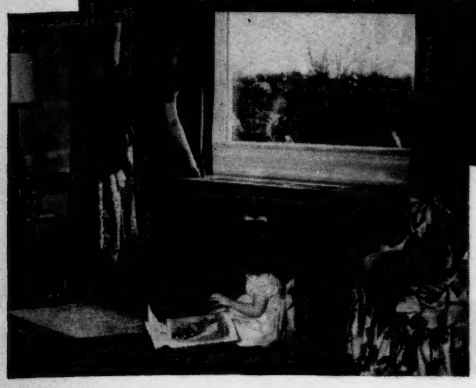
J-80271

TUNE IN ON HISTORY! Only Westinghouse brings you complete coverage of political campaign over CBS television and radio.

AIR HANDLING

*Reg. U. S. Pat. Off.

THE REMOTAIRE
by AMERICAN-Standard



Ideal for new construction or modernization of hotels, motels, office buildings, hospitals, schools, apartments, and residences. Permits individual weather control for each room.

● **THE REMOTAIRE** is designed for summer cooling and winter heating for multi-room installations. Individual control of each unit allows the occupant to choose the room temperature that suits him best without affecting adjoining spaces.

Chilled or heated water is supplied to the Remotaire through a simple piping system from a remotely located central water chiller and heating plant. Designed for location under windows, the Remotaire can be free standing or recessed into wall 4 inches.

The Remotaire is provided with an arrangement for introducing ventilation air through a wall aperture. However, ventilation air may be supplied by several other methods if desired.

Installation of the Remotaire is easy and simple. For descriptive literature on this new remote type room air conditioner, including dimensions and ratings, write for Form 298.

Design provides low cost installation . . . efficient performance . . . and minimum maintenance

1. . . . four standard control packages are available.

2. . . . coil is designed for either right or left hand connections and can be easily reversed in the field if necessary.

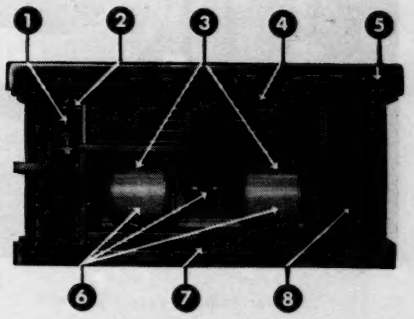
3. . . . exceptionally quiet with low speed fans and acoustically-treated air passages.

4. . . . coil shield over the top of the coil prevents foreign matter from falling into coil. Should liquid be spilled in air grille, the coil shield will safely carry liquid into drain so it will not injure unit or room floor nor interfere with operation of the Remotaire.

5. . . . rugged cabinet construction of sturdy, reinforced, furniture steel—plus a reinforced air grille—adds to permanence and long-lasting beauty of unit.

6. . . . fans and motor on single mounting plate permit easy removal if necessary.

7. . . . room ventilation can be adjusted —either manually or can be automatically operated—with the fresh air damper located in each unit.



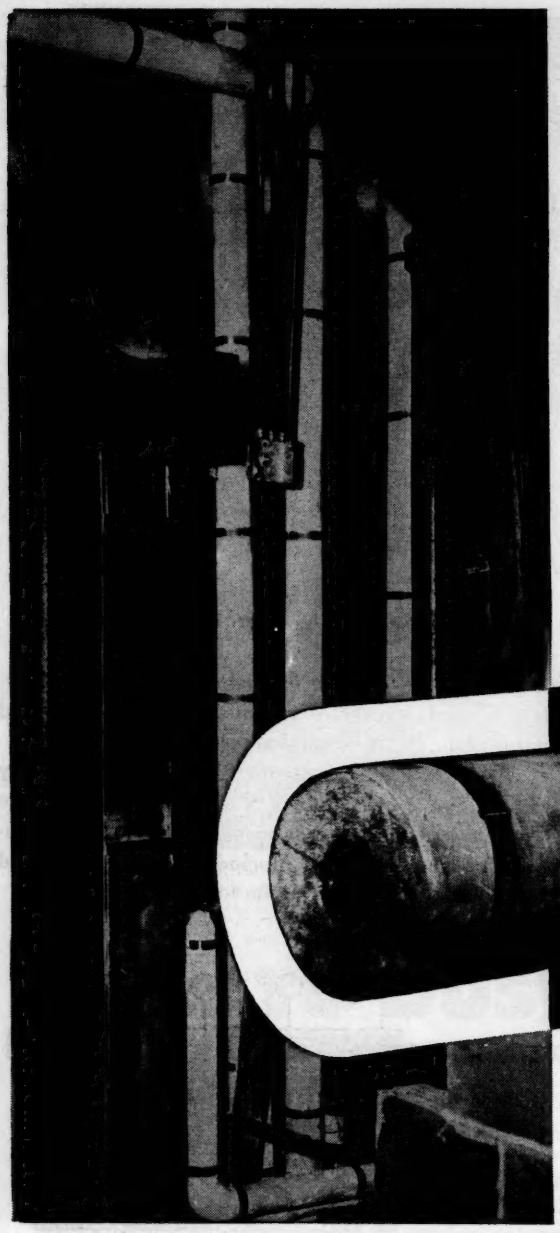
8. . . . spacious end compartments with removable end panels provide ease of installation and allow more than 90° horizontal wrench swing.

American Radiator & Standard Sanitary Corporation, Dept. HV-82, Pittsburgh 30, Pa.

AMERICAN-Standard
HEATING-COOLING

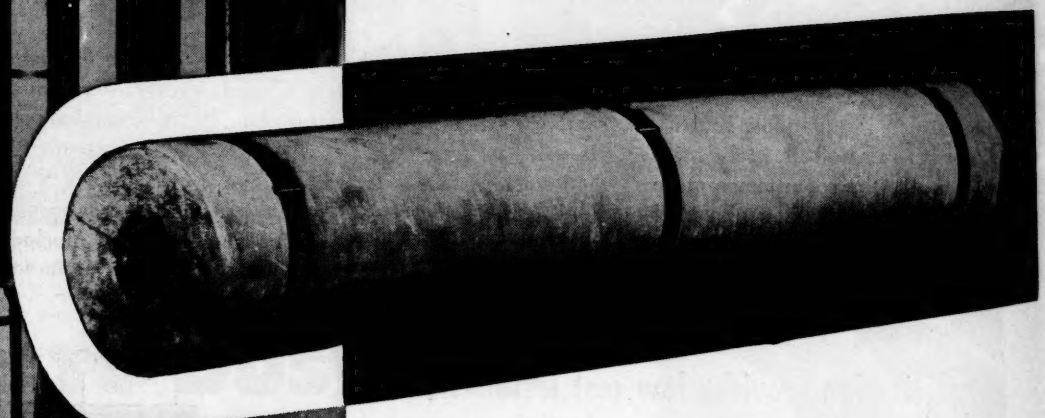
Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON



YOU SAVE FROM THE VERY BEGINNING WITH

Amocel



...the easy-to-use, long lasting pipe insulation

Probably no one will ever again need to see this installation of long-lasting Amocel, for "out of sight means out of mind" with this durable insulation. There's no concern about replacement, because Amocel lasts the life of the building, so steam and hot water lines need not be accessible for insulation maintenance. Amocel is Unarco's economical pipe insulation for all commercial uses up to 600°F. temperature. For higher temperatures—up to 1200°—specify Unarco Unibestos. Phone your nearby Unarco Distributor for information and from-stock deliveries. *Write for Bulletin 76-109.*

UNARCO

UNION ASBESTOS & RUBBER COMPANY

DEPT. B-8, 332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS

"We don't expect dealers to be magicians"

says Ray Bissell,

Bryant Gas Equipment, Inc., Baltimore, Md.

We may be old-fashioned, but we believe you dealers are in business to make money. Not just to turn over dollars, but to make a legitimate profit on a decent volume of sales. That's one reason we at Bryant do everything possible to *protect your profit margin*—give you top-quality, dependable products; permit you to save on installation costs; back you with technical assistance when you need it; and finally, help you promote and *sell* the more profitable jobs. No, we don't expect dealers to be magicians—to keep up a family, and a business, on profitless turnover. If this fits with your thinking, you'll be interested in Bryant's aggressive program for '52. We're going to make money, and help *you* make money. Your Bryant Distributor will give you the facts. Or write Bryant Heater Division, Dept. 145, Affiliated Gas Equipment, Inc., 17825 St. Clair Ave., Cleveland 10, Ohio.

Bryant Model 26 Gas-Fired Boiler

For all types of hot water heating systems—radiation, convection, baseboard and radiant panel. Nine sizes, with A.G.A. inputs from 67,500 to 315,000 Btu per hour. Approved for all gases. Ruggedly, compactly built. Highly dependable.

bryant® *best buy*

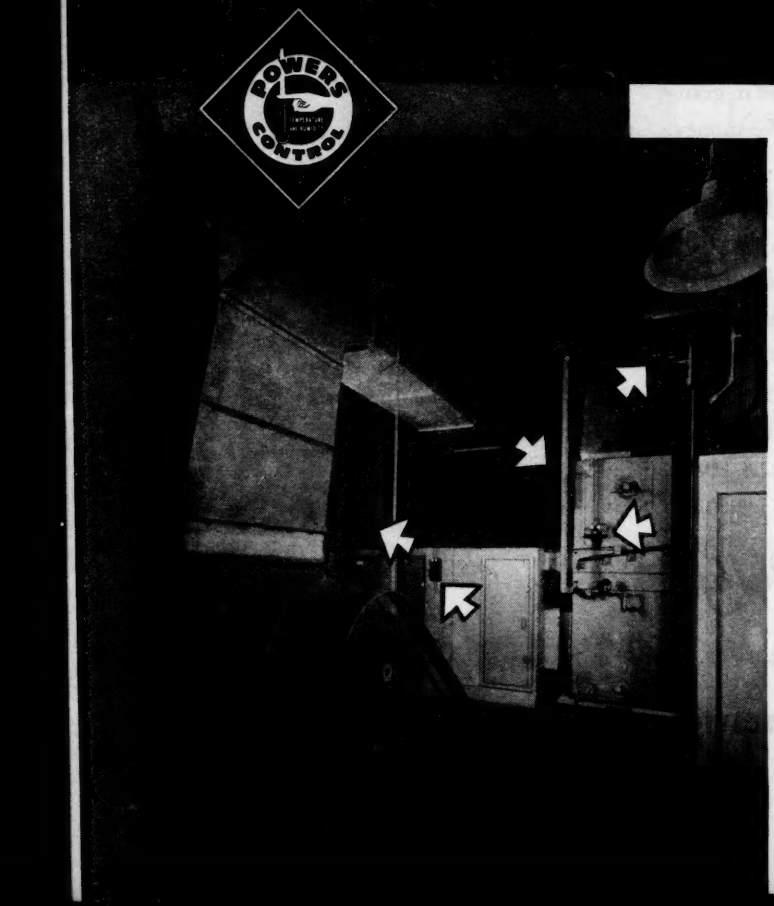
IN HEATING,

AIR CONDITIONING,

WATER HEATING

POWERS for Heating an

PNEUMATIC CONTROL SYSTEMS

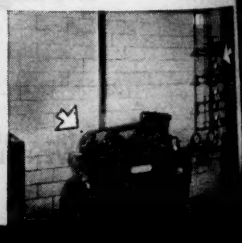


POWERS Design for MODERN CONTROL PANE

In the unique functional design of this Control Panel an integrated various types of POWERS pneumatic control ling, indicating and recording instruments. It mastermind the operation of four complete year round air conditioning systems in the modern plant shown on the next page.

Photos at left and top and bottom of next page show air conditioning systems regulated by the Control Panel. Arrows indicate Powers controls.

Photo below, left—shows four refrigerator compressors, one for each air conditioning system; photo right—Powers air compressor and pilot valves supplying air pressure for control system.



Air Conditioning

Pull Heating Costs Down As Fuel Prices Rise

POWERS TEMPERATURE and HUMIDITY CONTROL SYSTEMS

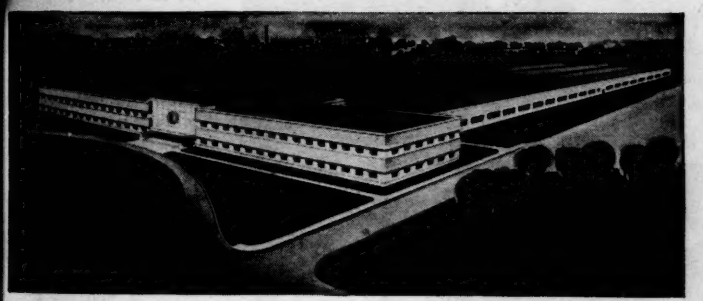
prevent OVER-heated air in offices, factories, process rooms and other spaces. Comfortable, healthful room temperature—not only increases output of workers, but—

★ **Cuts Heating Costs up to 25%**—Keeping each room at its proper temperature prevents waste of fuel from OVER-heating. With todays much higher fuel costs, bigger savings than ever before are now possible with Powers control.

Constant Temperature and Humidity conditions in each room can be maintained at any predetermined point with Powers control. It can be installed in existing as well as new buildings.

25 to 40 Years of Dependable Service with very low maintenance cost is reported by hundreds of users. Powers control is notable for its continuous accurate performance.

Precision Control for Processes—Wherever product uniformity and quality are dependent upon precise temperature and humidity regulation, use Powers controlling, indicating or recording instruments.



New modern plant commemorating 60th anniversary of The Powers Regulator Co., pioneer in pneumatic operated controls for heating, air conditioning systems and industrial processes.

Phone or write our nearest office for help in selecting the type of automatic control that will give best results for your requirements. There's no obligation.

THE POWERS REGULATOR CO.

Established 1891 • SKOKIE, ILLINOIS • Offices in Over 50 Cities

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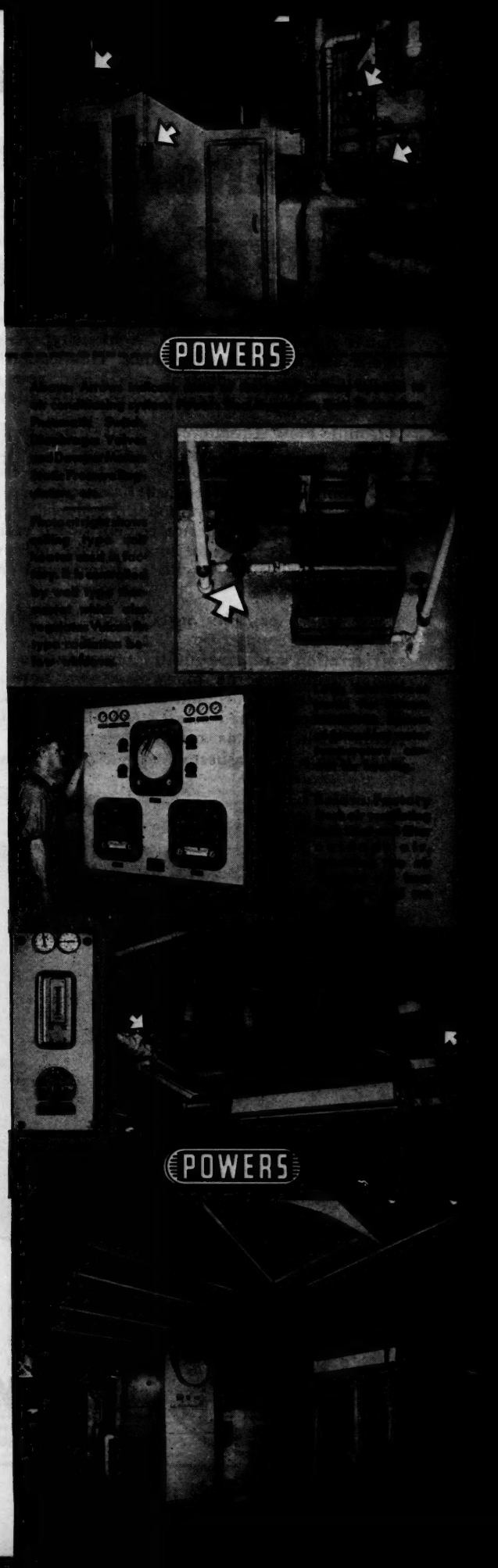
DETROIT 1, MICH., 2631 Woodward Ave. • TORONTO, ONT., 195 Spadina Ave.
PHILADELPHIA 32, PA., 2240 N. Broad St.



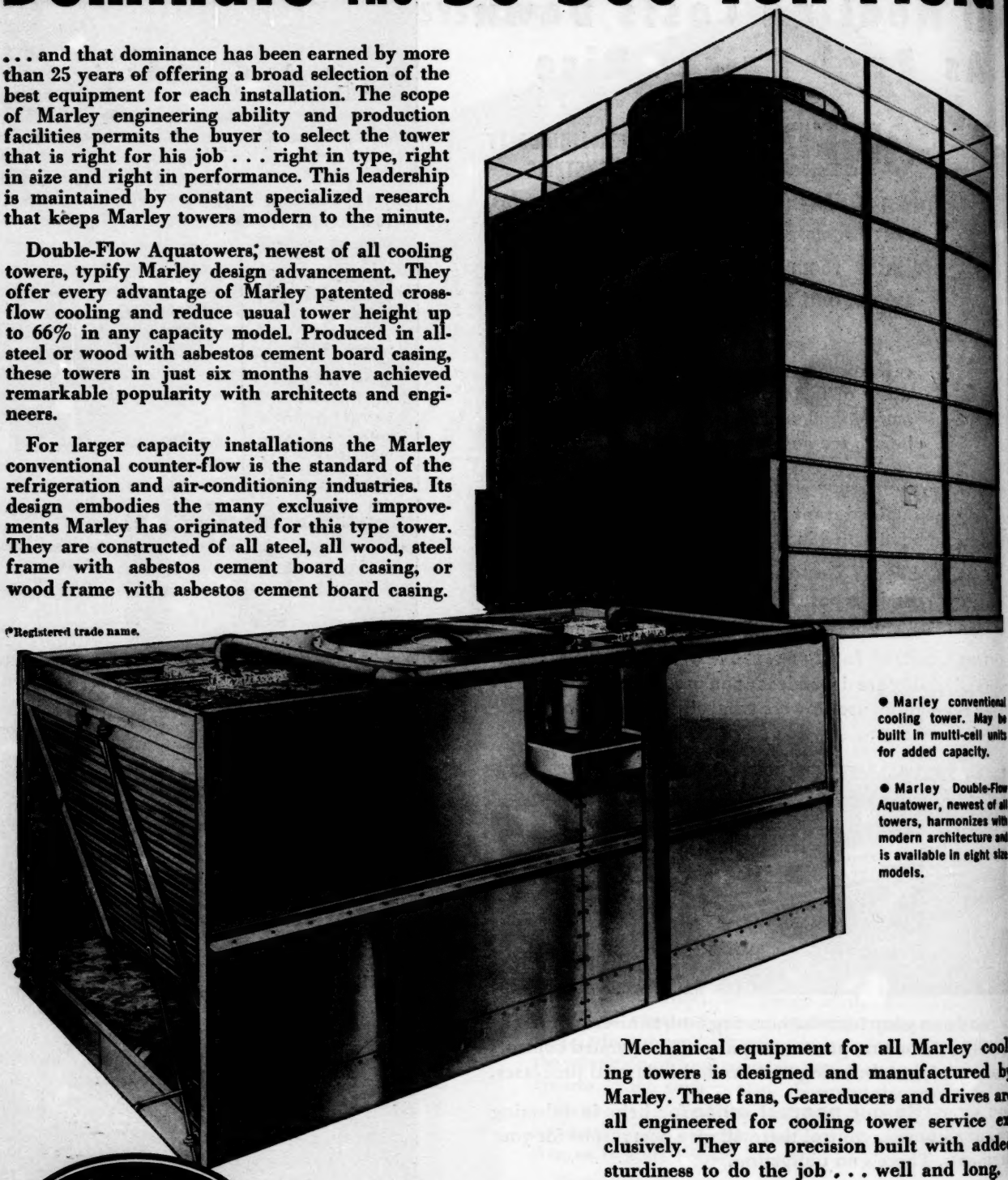
MARLEY Cooling Towers Dominate the 50-500 Ton Field

. . . and that dominance has been earned by more than 25 years of offering a broad selection of the best equipment for each installation. The scope of Marley engineering ability and production facilities permits the buyer to select the tower that is right for his job . . . right in type, right in size and right in performance. This leadership is maintained by constant specialized research that keeps Marley towers modern to the minute.

Double-Flow Aquatowers,* newest of all cooling towers, typify Marley design advancement. They offer every advantage of Marley patented cross-flow cooling and reduce usual tower height up to 66% in any capacity model. Produced in all-steel or wood with asbestos cement board casing, these towers in just six months have achieved remarkable popularity with architects and engineers.

For larger capacity installations the Marley conventional counter-flow is the standard of the refrigeration and air-conditioning industries. Its design embodies the many exclusive improvements Marley has originated for this type tower. They are constructed of all steel, all wood, steel frame with asbestos cement board casing, or wood frame with asbestos cement board casing.

*Registered trade name.



● Marley conventional cooling tower. May be built in multi-cell units for added capacity.

● Marley Double-Flow Aquatower, newest of all towers, harmonizes with modern architecture and is available in eight size models.

Mechanical equipment for all Marley cooling towers is designed and manufactured by Marley. These fans, Geareducers and drives are all engineered for cooling tower service exclusively. They are precision built with added sturdiness to do the job . . . well and long.

MARLEY

The Marley Company, Inc.

KANSAS CITY 5, MISSOURI

11 REASONS WHY—

YOUNG CONVECTORS ASSURE OWNER SATISFACTION

AIR SEAL
Strips of felt and/or corner gaskets prevent air leaks and resultant wall streaking.

DAMPER CONTROL
Chain control regulates damper and rate of air flow thru cabinet and heating element.

OVER-SIZE GRILLE
Louvers direct air outward and permit abundant heat delivery . . . greater capacity.

MODERN CABINET
Finished in prime coat . . . can be painted to match décor . . . safe, rounded corners.

SIMPLIFIED PIPING
Cabinet knock-outs and header casting design permit piping from top and bottom.

RADIANT HEAT
Heating element and adjacent surfaces help compensate for off-period heat loss.

HEATING ELEMENT
Sensitive non-ferrous tube-and-fin core is reinforced and protected by side plates.

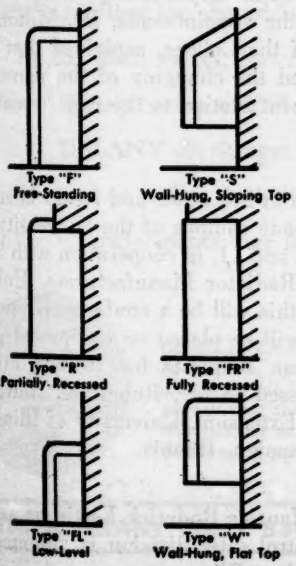
EASY TO CLEAN
Remove screws to release one-piece front panel for seasonal cleaning.

SIMPLIFIED HEATING ELEMENT SUPPORTS
Provide quick installation and pitching adjustments. Hold heating element securely.

PACKAGED FOR PROTECTION
Reinforced, stapled cartons protect convectors. Marked for easy identification.

STANDARD RATINGS
The ratings of Young Convectors have been determined in conformance with Commercial Standard CS 140-47, as developed cooperatively by the trade and the National Bureau of Standards, U. S. Department of Commerce, and the said ratings have been approved by the Convector Rating Committee.

SIX TYPES FOR EVERY INSTALLATION



Young Convector installations can be specified, installed and forgotten. Every care is taken in the engineering, rating and manufacturing of Young Convectors to produce heating elements that provide maximum heat transfer . . . to design cabinets that are attractive and can be painted to harmonize with room interiors. You'll appreciate the elimination of guesswork in Young approved ratings, the ease of installation, the protective packaging which simplifies handling and identification. The six standardized cabinet styles, shown at the left, are for use with any hot water or two-pipe steam system. See your nearest Young Representative, or write for Catalog Nos. 4049 and 4150.

1927 • 1952
25 YEARS OF PROGRESS IN HEAT TRANSFER ENGINEERING

YOUNG

Heating, Cooling, Air Conditioning Products for Home and Industry.

Heat Transfer Products for Automotive and Industrial Applications.

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YOUNG RADIATOR COMPANY
Dept. 522-H • RACINE, WISCONSIN
Factories at Racine, Wisconsin and Mattoon, Illinois
Sales and Engineering Offices in all Principal Cities

BRIEFLY STATED

• Progress toward the development of a new continuous-mining machine was recently described at a meeting of the coal industry's research organization, Bituminous Coal Research, Inc. Coal operators, working with manufacturers of mining equipment, have developed a new machine that employs a principle different from that of any other continuous miner. Rotating arms holding cutter bits score circular incisions in the coal seam. A bursting central cone pushes into the coal as the machine moves ahead, breaking coal out of the area within the scored circles. The loosened coal is automatically fed through the machine and onto conveyors or into mine cars. At this time there are about six different types of continuous-mining machines, either in actual production, or working experimentally in America's mines.

• Development of a relatively inexpensive, low power nuclear reactor, unique in that it is submerged in water to protect operators from radiation has been announced by the Oak Ridge Operations Office of the U. S. Atomic Energy Commission. The reactor is the central feature of a bulk shield testing facility which is used for experiments to aid development of improved reactor shields. The facility is popularly known as the swimming pool, since the reactor is submerged in a pool of water 20 feet deep, 20 feet wide, and 40 feet long, in which it can be moved about. The entire facility was constructed for less than $250,000, exclusive of fuel. Of this amount, the reactor core itself cost only $58,400, the rest of the cost being for concrete work, the building and auxiliary equipment. This swimming pool reactor has a continuous, full load power rating of 10 kilowatts.

• Start of a new long-term research project to learn exactly where Chicago's dirt comes from has been announced by Dr. Haldon A. Leedy, director of Armour Research Foundation of Illinois Institute of Technology. Cost of the program for the first year will be about $25,000. The Midwestern Air Pollution Prevention Association will sponsor the extensive project to be conducted by the Foundation. Dr. Leedy is president of MAPPA which includes engineers, industrialists, city officials, and others from the Chicago area interested in preventing local air pollution.

• Thomas D. Cartledge has been appointed president of Linde Air Products Co., a Division of Union Carbide and Carbon Corp. Mr. Cartledge has been senior vice president of Linde and a director and vice president of Dominion Oxygen Co., Ltd., a Union Carbide subsidiary.

• Howard A. Blair has been appointed product manager of self-contained products, Air Conditioning Division, Westinghouse Electric Corporation. Mr. Blair has been in charge of air conditioning service activities of the company for the past nine years. Following his graduation from the University of Cincinnati in 1929 with a degree in electrical engineering, Mr. Blair joined Westinghouse as a graduate student at East Pittsburgh, Pa.

• George Day has been appointed assistant sales manager, heating division, Richmond Radiator Co., manufacturers of gas-fired boilers and warm-air units. Mr. Day, before joining Richmond in 1948, was associated with a Chrysler-Air Temp distributor, and prior to World War II was with the Dole Valve distributor in New England.

• Joy Manufacturing Co., Henry W. Oliver Building, Pittsburgh 22, Pa., has announced the election of William L. Wearly to the post of general sales vice president in charge of all domestic sales including Canada and Mexico. Mr. Wearly joined the engineering department of Joy Manufacturing in 1937 and has served successively as service manager and vice president, coal machinery sales. A native of Indiana, he graduated from Purdue University in 1937 with a B.S. degree in Electrical Engineering.

• Acme Industries, Inc., manufacturers of air conditioning and refrigeration equipment have announced the appointment of R. E. Mercer as director of merchandising. Mr. Mercer is a member of ASRE, and prior to his association with Acme, was national sales manager for the Kalamazoo Stove and Furnace Co. Mr. Mercer subsequently announced that Carl Millsom has been appointed sales manager for Acme's air conditioning and refrigeration division. Mr. Millson also heads the Flow-Cold division, directing the merchandising of its packaged chillers, cooling towers, refrigeration accessories and heat pumps.

• Texas Gas Transmission Corp. filed a new application July 8 with the Federal Power Commission for authority to raise its wholesale natural gas rates by about $8,650,000. The new rate schedule would become effective August 8, 1952.

• Elmer R. Queer, professor of engineering research and assistant director of the Engineering Experiment Station at the Pennsylvania State College, has been appointed director of the department of engineering research and Paul Ebaugh, professor of engineering research, has been named assistant director of the department, both effective Sept. 1. In announcing the appointments, Dr. Milton S. Eisenhower, president of the College, explained that the trustee had also approved the changing of the name of the Engineering Experiment Station to the department of engineering research.

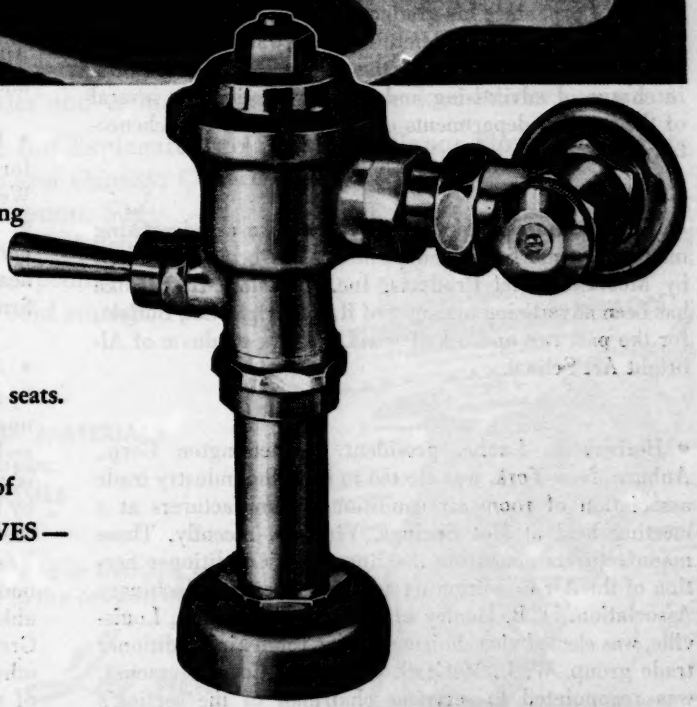
• The sixth short course in hot water and steam heating will be given on the Urbana campus of the University of Illinois, September 9, 10, and 11, in cooperation with The Institute of Boiler and Radiator Manufacturers. Unlike previous Short Courses, this will be a conference type of program. The emphasis will be placed on equipment performance and application. Requests for further information should be addressed to Mr. Robert K. Newton, Supervisor, Engineering Extension, University of Illinois, 715 Wright Street, Champaign, Illinois.

• The appointment of Maurice Roderick Eastin as assistant manager of the control sales division is announced by Perfex Corp., Milwaukee, Wis.

And in Laramie – A FUTURE OF FAULTLESS SERVICE

MEMORIAL FIELD HOUSE & STADIUM
University of Wyoming, Laramie, Wyoming
PORTER & BRADLEY
architects
GOODRICH & WILKING
associate architects
SPIEGELBERG LUMBER & BUILDING CO.
general contractor
SLACK PLUMBING & HEATING CO.
plumbing contractor

In this recent COYNE & DELANY installation a gigantic field house accommodating 11,500 persons is coupled with a 20,000 seat stadium, and the Rocky Mountain Region gains its finest sports facilities. Future plans for the stadium allow for the addition of 15,000 extra seats. As for flush valves, however, the future has already been provided for by the selection of DELANY diaphragm type FLUSH VALVES — designed to outlast the building, and to remain maintenance free in the process.



On all DELANY valves, an unnecessarily long flushing cycle may be reduced by the twist of a screw driver (left). This flexibility allows for all job site variables of pressure and volume. It is noteworthy that the DELANY Valve is the only diaphragm type with this positive setting, permanently free-turning and without watch-like moving parts subject to fouling.

DELANY *Flush* **VALVES** Since 1879

COYNE & DELANY CO. • 834 KENT AVE. • BROOKLYN, NEW YORK

IN CANADA: THE JAMES ROBERTSON CO., LTD.

• A fellowship for conducting systematic studies of standardization and its applications in science, engineering, production and marketing has been announced by Dr. Edward R. Weidlein, president, Mellon Institute, Pittsburgh, Pa. This fellowship will be sustained at the institute by a grant from the Sarah Mellon Scaife Foundation of Pittsburgh, and its projects will be organized and supervised by Dr. Dickson Reck, advisory fellow. Dr. Reck will work in cooperation with research specialists of the institute and with national authorities and societies. Dr. Reck is lecturer in business administration at the University of California.

• Wesley J. Peoples has announced that at a meeting of the board of directors of United States Radiator Corp., Roland P. Place, of Midland, Mich., was elected chairman of the board and W. C. McCord, of Dallas, Tex., was elected president. Both offices previously had been held by Mr. Peoples, who continues as a director of the company and as advisor and consultant. All other officers were reelected. Mr. Place, president of Michigan Chemical Corp., has been a director of U. S. Radiator since 1946. Mr. McCord, former president of Southland Life Insurance Co., is also a director of U. S. Radiator.

• M. E. Ziegenhagen has been named advertising and sales promotion manager of Worthington Corp., Harrison, N. J. Mr. Ziegenhagen has been associated with General Electric Corp. since his graduation from the University of North Dakota in 1937 where he was awarded a B. S. degree in mechanical engineering. Since 1946 he has been in charge of advertising and sales promotion for several of the product departments of General Electric's Schenectady plant.

• The appointment of Clayton A. Stahlka as advertising manager, a newly created position, has been announced by Morrison Steel Products, Inc., Buffalo. Mr. Stahlka has been advertising manager of R. G. Wright Co., Buffalo, for the past two and a half years. He is a graduate of Albright Art School.

• Herbert L. Laube, president of Remington Corp., Auburn, New York, was elected to head the industry trade association of room air conditioner manufacturers at a meeting held at Hot Springs, Virginia, recently. These manufacturers constitute the Room Air Conditioner Section of the Air Conditioning and Refrigerating Machinery Association. H. B. Donley of General Electric Co., Louisville, was elected vice chairman of the room air conditioner trade group. W. L. McGrath of Carrier Corp., Syracuse, was reappointed to serve as chairman of the section's engineering committee.

• The 80th annual meeting of the American Public Health Association and the annual meeting of 38 related organizations will be held in the Public Auditorium, Cleveland, Ohio, October 20-24. More than 5,000 professional public health workers from all parts of the free world are expected to attend.

• A new slate of officers was elected for the ensuing year at the 35th Annual Meeting of the Stoker Manufacturers Association held at Lake Wawasee near Syracuse, Indiana on June 23 and 24. LeRoy C. Dubs, Canton, Ohio president of the Canton Stoker Corporation was elected president. B. O. Fink, Auburn, Indiana, president of Auburn Foundry, Inc., was elected vice president and Howard B. Scoville, Rockford, Ill., assistant general manager, Cotta Transmission Company, was elected secretary-treasurer. Marc G. Bluth, Chicago, was re-appointed executive secretary.

• In a vast development program, The International Nickel Company of Canada, Limited, has installed ventilation fans which will supply an additional 1,250,000 cfm of fresh air. For example, at Creighton mine, deepest of Inco's five mines, a 124-inch diameter axial flow fan, driven by a 350-horsepower motor, is mounted on the collar of the return air shaft. Fresh air flows through each operating slusher drift on the various levels at Creighton mine at an average velocity of 175 fpm, while the volume of air exhausted is 10,000 cfm per slusher drift operating.

• Robert H. Collins, formerly of Omaha, Nebraska, has become a full partner in the Gaines Co., which will now be known as the Gaines-Collins Co., located at 1521 Compton Ave., Los Angeles. Gaines-Collins is embarking on a major foundry expansion program the first step of which is the doubling of plant capacity. The second step has been the acquisition of the 28-year-old Quijada Tool Co., Inc., and its complete manufacturing facilities at 5474 Alhambra Avenue, Los Angeles 32. Quijada tools are known in industries using pipe conduit or tubing.

• Herwart Werker has been appointed director of research for American Radiator & Standard Sanitary Corp. Mr. Werker was promoted to his new position from the post of manager of the heating division of the research department. In his new job he will direct all plumbing, heating and air conditioning research conducted by the firm.

• A $100,000 dealer education program has been launched by Minneapolis-Honeywell Regulator Co. in a major attack upon the problem of upgrading sales among its own dealers and those of other companies as well. The undertaking is a long-range attempt to make dealers better salesmen by teaching them—through a new and unusual medium—the fundamentals of effective and profitable merchandising. Heart of the program is a series of seven new how-to-do-it books published by Honeywell and now being made available to others in the industry. Entitled, "Seven Steps to Greater Dealer Sales," the books are offered along with other supplementary material. Although the initial use of the plan will be in this field, it is applicable to any industry that sells through dealers and requests for the package already are being received from outside the heating industry. The books not only tell the dealer what to do, but they show him how—and in a manner designed to get him to take definite action. A separate book of 20 to 40 pages is devoted to each of seven merchandising steps, embracing sales training, personal selling, advertising, selling by mail, exterior display, interior display and public relations.

Why does "rain" often form inside roof spaces of a crowded store or school? (pages 19, 32)

Why does moisture gather on a water-and-vapor-proofed concrete floor? (page 32)

Why is it wrong to vent cold roof spaces to a warm inside space? (page 33)

Does a concrete floor slab lose heat only at the edges? (page 40)

In what direction does heat flow by Conduction? Convection? Radiation? (pages 11, 15)

Do "dead air spaces" exist with respect to heat flow? (page 16)

Why do metals radiate and absorb less heat than wood, plaster, rockwool? (pages 13, 46)

Why replace low-conductive air with denser materials of greater conductivity, i.e. ordinary insulation. (pages 11, 13, 14, 29)

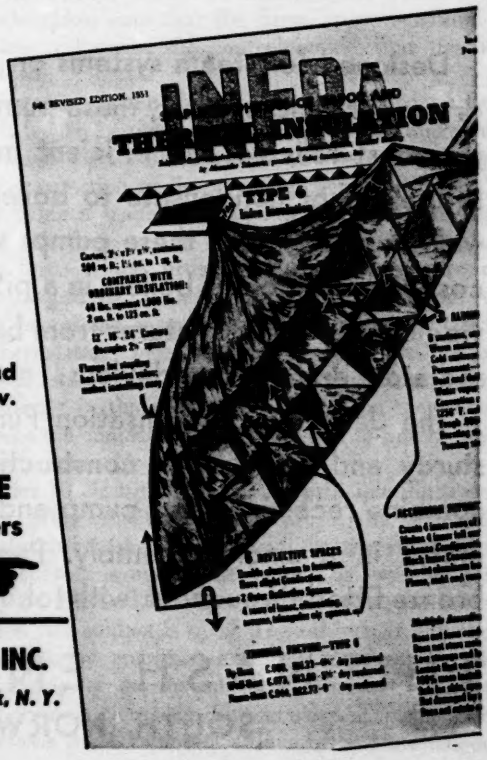
The answers to these and numerous other problems of heat and vapor flow are found in the pages of the Revised Fifth Edition of

SIMPLIFIED PHYSICS of Vapor and THERMAL INSULATION

By Alexander Schwartz

Written in simple language easy to understand, yet accurate and complete enough to gratify the scientist. Crammed with information the engineer, architect, public official, builder, contractor, insulator, heating installer, need. Hundreds of universities and technical schools use previous editions as a text.

56 pages of Facts, Figures, Charts, Illustrations, and Explanations of Heat and Vapor Flow; Vapor Permeability; Condensation; Dry Rot; Conduction and Density; Convection; Radiation and Emissivity; Reflection and Absorption. Suggests solutions and illustrated techniques for practical problems of insulation installation, condensation, protection against heat loss or intrusion, radiant heating; cold storage.



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These 2 charts are indispensable to anyone interested in building and heating. THE VALUABLE MANUAL IS FREE! Just fill in the coupon below.

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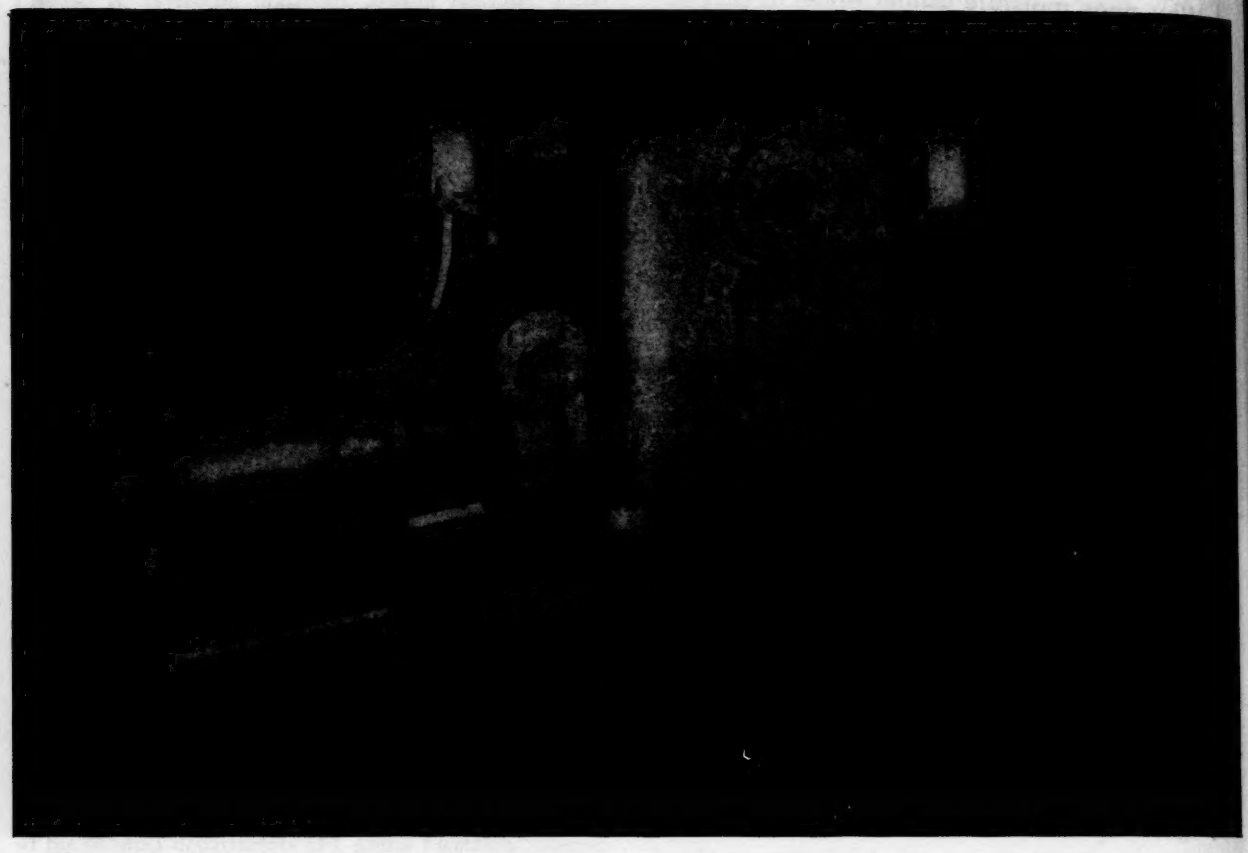
MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



JENNINGS CONDENSATION PUMPS

Designed for steam systems on heating, drying, or process work, these pumps offer the most reliable and efficient means of returning hot condensate to boiler or hot well. In many cases these pumps will save costly installation of boilers in a pit to provide gravity flow of returns from basement radiators and heating devices.

The Jennings Condensation Pumps are sturdy and compact in construction, and combine receiving tank, pump and driving motor in a single assembly. Pumps are bronze fitted throughout, with tobin bronze shaft. The pumping impeller is of special design, made possible by our wide experience with return line heating pumps, and is especially adapted for handling hot water with the greatest possible efficiency.

Full automatic control is furnished by means of a ball float and float switch mechanism mounted on the receiving tank. All wiring is made up at the factory, and it is necessary only to connect the pump to the system and hook up the leads. Complete information regarding these economical pumps sent promptly on request.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

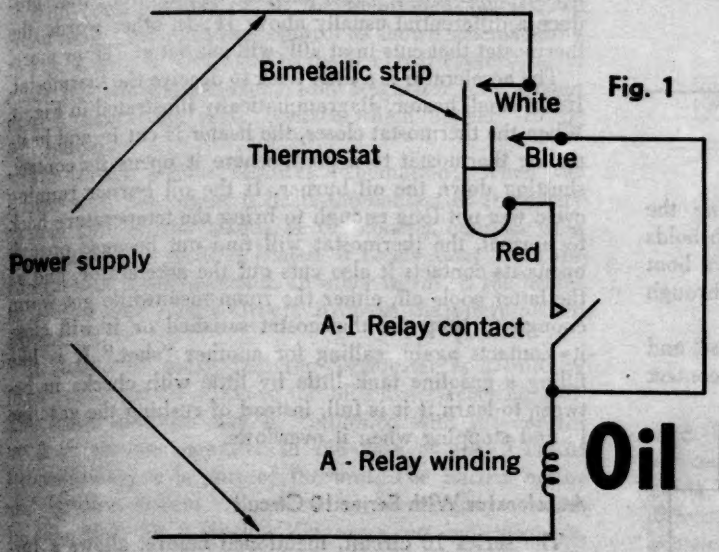


Fig. 1

WERNER G. HOLZBOCK

Relay Circuits for Operating Oil Burner Controls

Some of the methods and problems encountered in the design of relay circuits for oil burner controls. A number of typical circuits are illustrated and described.

OIL burners are useful because they provide an economical and clean source of heat supply. They are relatively safe in operation and one of the major causes for this safety are their controls which consist usually of electrical relay circuits combined with flame detectors and valves. They supervise the proper performance of the oil burner and shut it down when conditions come up that no longer warrant safe operation. The latter action is called safety shutdown. Other functions of oil burner controls include: Starting the oil burner, timing the ignition, opening the oil valves.

Most oil burners consist of three essential parts: (1) an oil pump which forces the oil under pressure through a nozzle from which it issues as a fine spray into the combustion chamber, (2) a fan which provides the air for combustion, and (3) an electric ignition system which ignites the oil-air mixture by means of an electric spark. Oil pump and fan are coupled together. When speaking of an oil burner motor, it is usually understood that one refers to the assembly of motor, pump, and fan. To shut down an oil burner, the power to the motor is cut off.

A flame detector is required to detect the presence of a flame. A thermostat, pressure controller, or similar device, is installed to signal variations of the controlled variable (temperature, pressure) to the oil burner, and thereby to control the heat input necessary to maintain the controlled variable as constant as possible. (We always speak of thermostats, even when a pressure controller or other equivalent, could be used instead.) Pressure controllers, just as low-water controllers, may be used to protect the boiler from too high pressure or too low water level by shutting the oil burner down when safe operating limits are exceeded. All these features are centralized in the oil burner relay control.

Assume the oil burner relay control receives a signal from the thermostat calling for heat. The control would make sure that the flame detector signals "absence of flame". If the flame detector would signal "presence of flame", obviously something would be wrong, since the flame cannot be there while the oil burner has not yet started. Only a defective piece of equipment, most likely the flame detector itself, could cause such a situation. The oil burner relay control would not start the oil burner under such conditions. If, however, conditions are normal, the control would energize the ignition system and the burner motor. A timing cycle would then start which makes sure that the flame appears within a certain time, otherwise the control would shut the oil burner down.

The thermostat is the monitor of the oil burner relay control. It has to be precise in its information and shattering contacts cannot be tolerated. This is accomplished by either snap action or the so-called "series 10 circuit", the latter being a trade mark of Minneapolis-Honeywell Regulator Co. Snap action consists of either spring or magnetic force which provides a contact pressure of sufficient magnitude to hold this contact in spite of vibration or minute movements in the actuating parts of the thermostat. Once the contact is made, the oil burner will start and the rise of temperature stores enough energy in the actuating parts of the thermostat to overcome the contact-holding force and to finally open the contacts again by snap action.

The series 10 circuit is based on a principle illustrated in Fig. I. When the temperature drops, the bimetallic strip of the thermostat slowly bends to the right. First the white contact is made, but as long as the blue contact is open, this will not energize the A-relay winding because the A-1 contact is open. The oil burner will start when the A-relay energizes and this requires that the bimetallic strip of the thermostat continues to bend to the right until it closes the blue contact. The energized A-relay closes its A-1 contact although the simultaneous

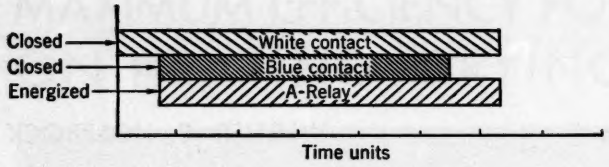
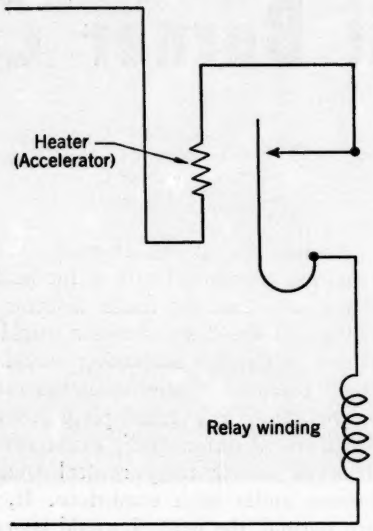


Fig. 2. Schematic of time sequence.

action on the oil burner is not shown. Opening the blue contact would not influence the A-relay which holds itself energized by its own contact, A-1, by its own boot straps so to speak, or in more technical terms, through a lock-in contact.

The oil burner will run, the temperature will rise, and the bimetallic strip will move to the left. The blue contact will open but this will have no direct consequence. Finally, the white contact will open and now the circuit through the A-relay winding is broken with the result that A-relay will drop out, opening contact A-1, and simultaneously stopping the oil burner. Fig. 2 shows schematically the time sequence of the described actions.

Fig. 3. Heater or accelerator in circuit.



Many thermostats are equipped with so-called accelerators designed to avoid "overshooting," a term which will become clear from the following description.

Oil burners are essentially on-off heating devices. Where modulation of the heat supply is desired, valves in the heat distribution system must be controlled, rather than operation of the oil burner. Although commercial oil burners are frequently equipped for the regulation of the flame from high to low, this does not change the fact that modulation, i.e., regulation in integral steps, is not used with such burners. The output of heat from the oil burner is spasmodic and not continuous.

Furthermore, there is a time element involved. When the thermostat calls for heat, it takes some time until it can be supplied; when the oil burner is shut down, because the thermostat is satisfied, there is heat stored up in the heating system which will raise the temperature beyond the point which satisfied the thermostat. The larger this heat capacitance, the more pronounced is this effect which is called overshooting. And it is aggravated by the fact that a thermostat which calls for heat at, say 70F will not be satisfied at, say 70.001F. There are inherent conditions, which include lost motion, that produce a differential usually above 1F. In other words, the thermostat that cuts in at 70F will cut out at 71F or more.

The accelerator is a little trick to deceive the thermostat. It is a small heater, diagrammatically illustrated in Fig. 3. When the thermostat closes, the heater is cut in and heats up the thermostat to a point where it opens its contact, shutting down the oil burner. If the oil burner running cycle was not long enough to bring the temperature back to normal, the thermostat will find out because once it opens its contacts it also cuts out the accelerator, and as the latter cools off, either the room meanwhile got warm enough to keep the thermostat satisfied or it will close its contacts again, calling for another "shot." It is like filling a gasoline tank little by little with checks in between to learn if it is full, instead of rushing the gasoline in and stopping when it overflows.

Accelerator With Series 10 Circuit

The series 10 circuit, mentioned before, allows a further refinement when used with an accelerator. However, the manufacturer only uses it in a few of his devices. When the accelerator is connected between the bimetallic strip and red terminal, Fig. 1, it will not function as long as the blue contact is closed, because the circuit through the blue contact would shunt out the accelerator located in the red-contact circuit. The thermostat acts thus without accelerator as long as the blue contact is closed; but once the temperature has increased sufficiently to open the blue contact, the accelerator comes in and rapidly heats the thermostat sufficiently to also open its white contacts shutting down the oil burner before the room temperature has actually risen to the point which would satisfy the thermostat without accelerator.

It was mentioned that the reasons for overshooting are the heat capacitance of the system and the differential of the thermostat action. The method just described would essentially counteract the differential because it only becomes efficient once the blue contact opens. Where the heating capacitance is considerable, it might be better to have the accelerator in the wire which leads from the white contact. While it might be possible to establish data relating heat capacitance to the method of accelerator

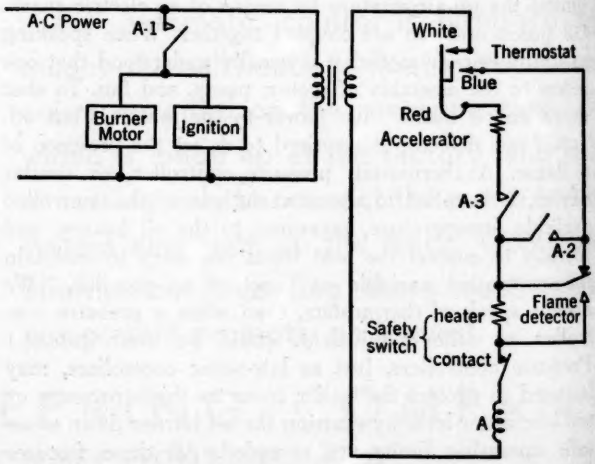


Fig. 4. Oil burner control which includes a safety switch.

connection, no work of that type is known to the author.

With consideration of all the mentioned factors, we could design an oil burner control as shown schematically in Fig. 4. This is very close to the RA116B Protectorelay, made by Minneapolis-Honeywell Regulator Co., except that it omits one relay contact which appears to be superfluous.

The safety switch requires explanation: When the heater is in the circuit it heats the contact of the safety switch. One of the blades of the contact consists of a bimetallic strip. As it is heated, it bends away from the contact and finally opens it. In other words, if the heater is long enough in the circuit, it opens the safety switch contact.

It should be noted that the thermostat is a unit by itself connected by wires to the oil burner relay control. The flame detector may be combined with the control or it might be separate. In the case of the RA116B Protectorelay, it is part of the unit. The burner motor and ignition system are, of course, also separate units. In this and the following diagrams, no indication is, however, given if parts of the system are physically independent or not.

Operation of Safety Features

When the temperature decreases, the thermostat closes its white contact first. For reasons mentioned before, this is of no consequence because the A-3 contact is open. When the blue contact closes, a circuit is established which runs from the secondary of the transformer through the white contact, the blue contact, the "break" contact of the flame detector, the safety switch heater, the safety switch contact, and the A-relay winding back to the secondary of the transformer. It will be noted that this circuit is only possible when the flame detector has the break contact closed proving that it is in good working condition. The A-relay will now energize, pulling in contact A-1 which will start the burner motor and the ignition system. Contact A-3 locks in the A-relay, holding its winding energized even if the blue contact opens. Contact A-2 closes shunting out the accelerator even though the same detector responds and removes the shunt it initially provided. As long as the flame detector is in its initial position, the safety switch heater is in the circuit, and if nothing else occurs, it will supply sufficient heat to open the safety switch contact after a pre-determined

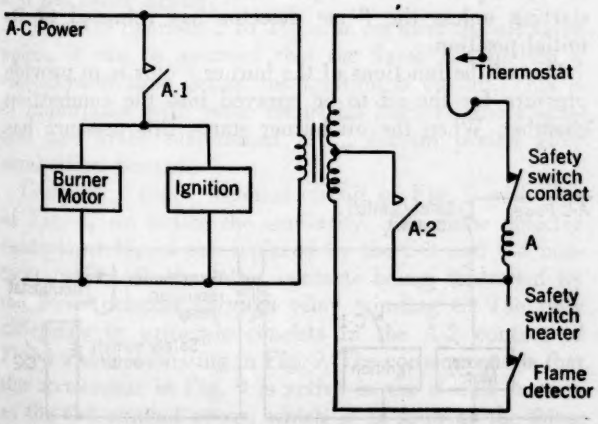


Fig. 5. Circuit used with the Penn Saftrol.

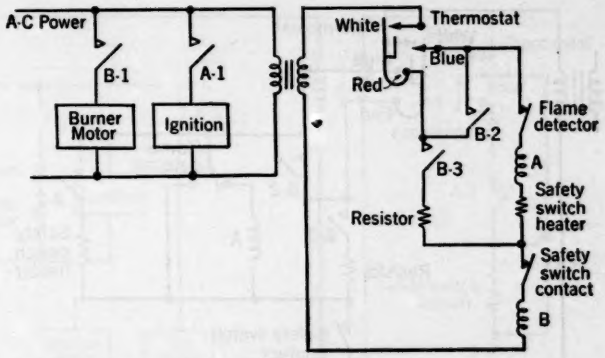


Fig. 6. Ignition system is cut out with this circuit as soon as the flame appears.

time. This safety switch will latch itself out once it opens, and only by manually depressing the latch will it be possible to close the safety switch again. Under normal conditions, however, the oil will ignite and the flame will actuate the flame detector which will transfer its contact from the break position to the make position, i.e., opening the upper and closing the lower contact in Fig. 4. This will shunt out the accelerator and normal operation can continue until the thermostat opens the white contact, de-energizing the A-relay.

The introduction of the transformer is necessary to have the thermostat wiring at low voltage.

Fig. 5 shows schematically a circuit which is used with the Penn Saftrol, Type 670, manufactured by Penn Electric Switch Co. Similar devices are made by General Controls Co. and White-Rodgers Electric Co. The thermostat features snap action. Again we find that the A-relay could not be energized unless the flame detector contact is in its initial or closed position. It should be noted that no open wire in the circuit could pass unnoticed. There is only one critical point, which is hardly avoidable—the safety switch contact which is depended upon to open in case of flame failure.

When the thermostat in Fig. 5 closes, it establishes a circuit through the safety switch contact, the A-relay winding, the safety switch heater, the flame detector, and back to the thermostat. As the A-relay pulls in, it locks itself in through the A-2 contact. The A-2 contact does not shunt out the safety switch heater because it taps the transformer at a lower voltage. The safety switch heater is cut out only after the flame detector reacts to the oil burner flame, opening its contact.

Quite in general, a good circuit is one which gives the optimum in performance with a minimum of contacts and complications, and a maximum of safety in operation. Contacts are all too easy the source of trouble; it is not only economy but also the condition of trouble-free service that makes reduction of contacts so important.

Fig. 4 and Fig. 5 show circuits where the ignition system would function as long as the burner motor is running. It is frequently preferred to have the ignition system cut off as soon as the flame appears.

A circuit for this purpose, which was worked out by the author for the sake of illustration, appears in Fig. 6. Contact B-2 is only necessary if it is desired to add an accelerator in the thermostat and shunt it out as long as the blue contact is closed. When the thermostat calls for heat, closing first the white then the blue contact, it

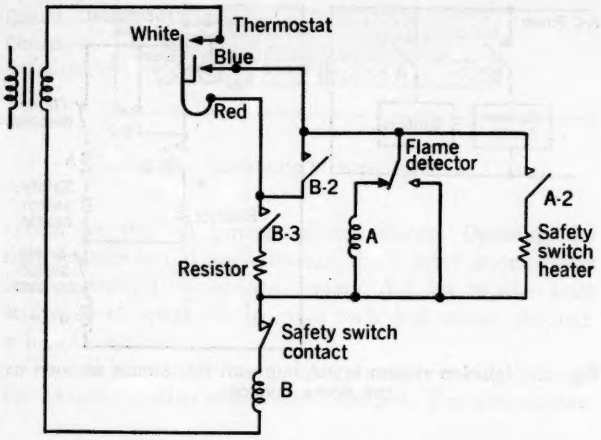


Fig. 7. An improvement over the circuit shown in Fig. 6.

establishes a circuit which can be traced from the transformer to the white and blue thermostat contacts, to the flame detector contacts through the A-relay winding, the safety switch heater, the safety switch contact and through the B-relay winding back to the transformer. The B-relay locks itself in through the B-3 contact which is in series with a resistor. This resistor avoids shunting out the safety switch heater and the A-relay winding by a short circuit through the B-3 contact.

An open in any of the relay windings or in the safety switch heater would interfere by not allowing the burner motor to start.

When initially the A- and the B-relay windings become energized, they start the burner motor and the ignition system through the two contacts B-I and A-1 respectively.

What happens if the oil burner started without trouble, but while it is running (1) the flame goes out for some accidental reason, and (2) although the flame detector responds, its contact does not close well enough to obtain an adequate resistance-free path through the safety switch heater to enable it to heat up sufficiently for the operation of its circuit? The oil burner would then not go into safety shutdown, although the situation calls for it, and we have quite a hazardous condition.

Since contacts are usually much more liable to fail in closing because of dirt than to fail in opening because of "freezing" or welding together of contacts because of sparking, it might be thought preferable to redesign the circuit of Fig. 6 into the one shown in Fig. 7. In the latter circuit, opening the contact of the flame detector during operation of the oil burner cuts the safety switch heater in the circuit.

Ignoring at first the added contact A-2, the difference in the two circuits is: The single contact of the flame detector was made a transfer contact and the safety switch heater is no longer in series with the flame detector but in parallel.

The safety switch heater is thus shunted out when the flame appears and the flame detector transfers its contact. A new trouble source appears: The flame detector's make-contact (right-hand contact) might not close well and have enough resistance to allow sufficient current to flow through the safety switch heater. The consequence would be that the safety switch actuates without obvious reason. In order to avoid this, the A-2 contact is added to open the circuit through the safety switch heater in addition to the shunt applied by the flame detector make-contact.

In doing this we eliminate one problem and add another. The flame detector in returning to its initial position has to energize the A-relay winding, otherwise the A-2 contact stays open and the safety switch heater does not heat up as it should. It is true, that the A-relay winding can operate under a higher resistance of the flame detector contact than the safety switch heater in Fig. 6 could, and this could be argued in favor of the arrangement. The other objection that might be raised is that the A-2 contact now, instead, depends upon the flame detector contact in Fig. 6. Probably, there is more force available with the relay controlled A-2 contact than usually with the flame detector controlled contact. These somewhat contradictory thoughts show how compromises are necessary in circuits and how difficult it can become to evaluate them. The arrangement shown in Fig. 7 is a principle used by Minneapolis-Honeywell Regulator Co. in their R161A Protectorelay.

Function of Transformer Repulsion Relay

Fig. 8 is a schematic diagram of the Type KMI Pyratherm made by the Mercoid Corp. In the transformer repulsion relay, the secondary of the transformer is repulsed from the primary when the thermostat closes the secondary circuit. The repulsing force is due to electromagnetic interaction between primary and secondary. Since the secondary is pivoted on one side, it swings around the pivot actuating a mercury switch shown in Fig. 8 as A-1. This starts burner motor and ignition system. C-1 and C-2 are contacts of the flame detector. When the flame detector responds to the flame, C-1 opens disconnecting the ignition system and C-2 closes shunting the safety switch heater. In case the flame detector does not respond, C-2 stays open and the safety switch heater continues in the circuit until by the action of its safety switch contact, the power line to the entire control system, the burner motor, and the ignition system is opened. The safety switch contact locks itself out by mechanical latching and can be released only manually by push button.

All switching action is done by mercury switches and it is mechanically not possible to tilt switch A-1 to its closed position, unless C-1 is in its closed and C-2 is in its open position. This prevents the oil burner from starting unless the flame detector has returned to its initial position.

One of the functions of the burner motor is to provide pressure for the oil to be sprayed into the combustion chamber. When the oil burner starts, this pressure has

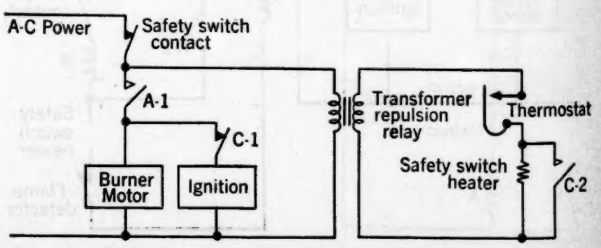


Fig. 8. Schematic diagram of Type KMI Pyratherm.

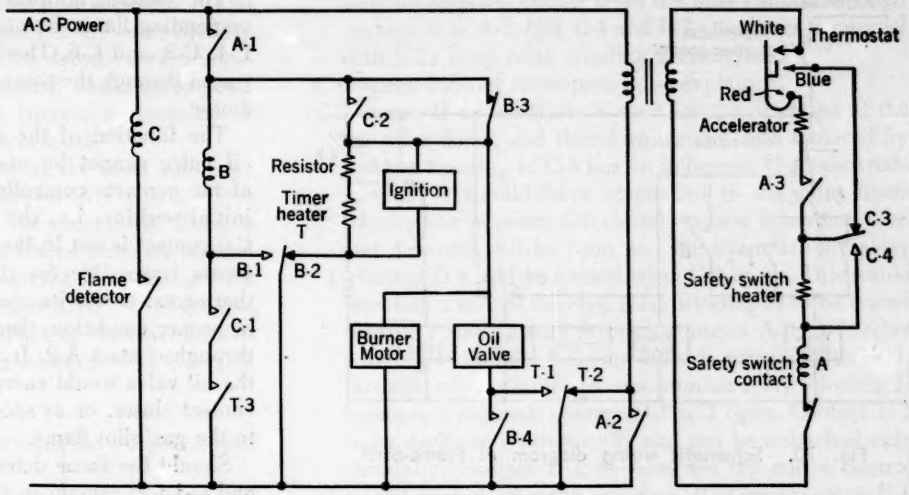


Fig. 9. Diagram of the M-H Protectorelay. Thermostat circuit is similar to Fig. 4.

to build up. In most industrial oil burners, it is undesirable that the oil is allowed to flow before the full operating pressure is obtained. These cases require a solenoid oil valve which can be electrically opened and closed, and provision in the oil burner relay to open the oil valve at a predetermined time after starting the burner motor. Fig. 9 gives a diagram of a design for this purpose, the R161B Protectorelay by Minneapolis-Honeywell Regulator Co.

The C-relay becomes necessary because the responses which the flame detector causes in the relay circuit are so diversified that the relay has to multiply the action of the flame detector.

The timer heater *T* is introduced to produce several timing actions: A few seconds after the system responds to a call for heat from the thermostat, it opens the break contact T-2. The heater continues warping the bimetallic strip and after 30 seconds, the make-contact T-1 closes, completing the circuit through the oil valve. In another 2 to 2½ minutes (depending on adjustment setting), contact T-3 closes, energizing the B-relay winding, provided the flame response of the flame detector has energized the C-relay winding thereby closing the C-1 contact (A-1 is closed because of energization of the A-relay winding in the thermostat circuit). Once the B-relay winding is energized, its contact B-1 operates, holding the relay energized, although A-1 and T-2 might open again. Contact B-1 also disconnects the ignition system and the timer heater.

Since T-3 operates 2 to 2½ minutes after the oil valve opens, it can be assumed that the flame has ignited a considerable time before the ignition is cut off. This is of importance with some industrial burners where ignition has to be maintained for a certain period after combustion occurs.

Comparing the thermostat circuit of Fig. 9 with that of Fig. 4, we notice the similarity. The flame detector contacts of Fig. 4 are replaced by the C-3 and C-4 contacts in Fig. 9, the latter contacts being controlled by the flame detector through relay winding *C*. The only difference in principle consists in the A-2 contact of Fig. 4 which is missing in Fig. 9. The consequence is that the accelerator in Fig. 9 is active in the circuit as soon as the C-3 contact opens, which is as soon as the flame detector responds to a flame. In the circuit of Fig. 4, the accelerator would be shunted until the blue contact opens.

To avoid the chance that the oil burner can start when the T-1 contact is closed, which would mean that the oil valve opens without the desired delay, the arrangement of the A-2 contact in parallel with the T-2 contact is provided. After a call for heat from the thermostat is satisfied by the oil burner and the thermostat opens its contacts, A relay drops out and contact A-2 opens. Unless contact T-1 is closed (and consequently T-1 is open), the primary of the transformer is thus disconnected. Consequently, the secondary of the transformer is also de-energized and no call for heat from the thermostat can energize A-relay until closure of contact T-2 restores conditions which make operation possible.

It is frequently desirable to provide a so-called scavenger period, to avoid restart of the oil burner after normal shutdown unless a certain time has elapsed. This could be done in the circuit of Fig. 9 by modifying the circuit in such a way that the timer heater would be left in the circuit as long as the oil burner runs. The consequence would be that once the oil burner shuts down, it cannot restart until the timer heater has cooled down sufficiently to close contact T-1. As mentioned in the previous paragraph, the oil burner cannot start without T-2 being closed. The cooling time of the timer heater would then provide the necessary scavenger period. This is actually done in the same manufacturer's R161A Protectorelay.

In the R161B model, to which Fig. 9 corresponds, the purpose is, however, to cut the timer heater out as soon as it fulfills its purpose, to have it cooled during operation of the oil burner, and to have the system ready for restarting immediately after the oil burner shuts down. To accomplish this, the lock-in contact B-1 becomes necessary. It allows the T-3 contact to return to its initial, open position during operation of the oil burner without any interference. For a similar reason B-4 becomes necessary because without it the oil valve would close when T-1 opens.

The self-supervision of this circuit would not be complete without contacts C-2 and B-3. They make sure that in case of the B-relay being defective and not dropping out when the thermostat opens its contacts, the oil burner cannot start.

The industrial oil burner types, most frequently used in middle-sized heating plants, require gas-electric ignition.

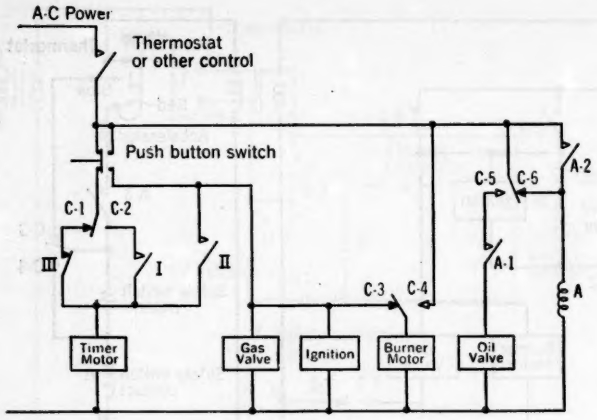


Fig. 10. Schematic wiring diagram of Flame-otrol.

This means that the electric spark is not sufficient to ignite the oil but a gas flame is required for this purpose. The gas in turn is ignited by the electric spark. Control systems are available which make sure that the gas flame is present before the oil valve is opened. They usually work in combination with photoelectric flame detectors. Since, however, the radiation of the gas flame is too different from the oil flame, it is necessary to detect the gas flame by separate means, usually an electrode that reaches into the gas flame. Since the gas flame in itself is a high resistance conductor, it closes a circuit from the electrode through the flame to the gas burner and to ground. The electrode cannot be used for an oil flame because the oil flame does usually not contact the burner but burns in suspension. A photoelectric cell is used for the oil flame. Circuits for such equipment are usually so designed that first the electrode detects the gas flame; this allows the oil valve to be opened. When the oil flame appears, the photoelectric cell takes over automatically all control action from the electrode.

Flame-otrol Circuit

Fig. 10 is the schematic wiring diagram of No. 1123-A Flame-otrol made by Wheelco Instrument Co. A low-fire relay, with its contact and capacitor, part of the 1123-A Flame-otrol are omitted since they have no bearing on our investigation. Contacts C-1, C-2, C-3, C-4, C-5 and C-6 are controlled by the flame detector, monitored first by the electrode for gas flame detection, then by the photoelectric cell for oil flame detection.

In circuits described before, heaters were provided for timer and safety action. These heaters are now replaced by a small synchronous motor. A slow revolving speed is obtained by the necessary gear train and a cam operates switches at certain intervals. These switches are indicated in Fig. 10 by contacts I, II, and III.

The thermostat is now in the high-voltage circuit and no transformer is used. When it closes its contact, a circuit is closed through the thermostat, the push button switch, contacts C-1 and III, and the timer motor. The timer motor starts to run and first closes contact I, then contact II. As II closes it completes three circuits which are all in parallel to the timer motor and likewise energized. These circuits through contact II continue through either the gas valve, or the ignition, or the burner motor. All three become energized.

The electric ignition system ignites the gas and the responding flame detector actuates contacts C-1, C-2, C-3, C-4, C-5, and C-6. The burner motor circuit can now be traced through the thermostat, contact C-4 and the burner motor.

The function of the A-relay is to make sure that the oil valve cannot be opened without previous returning of the contacts controlled by the flame detector to their initial position, i.e., the position shown in Fig. 10. If the C-6 contact is not in the position shown in Fig. 10, it becomes impossible for the A-relay to pick up when the thermostat closes its contacts. If, however, everything is in proper condition, then the A-relay would lock itself in through contact A-2. It would also close contact A-1 and the oil valve would energize and open as soon as the C-5 contact closes, or as soon as the flame detector responds to the gas pilot flame.

Should the flame detector fail to respond, contacts C-1 and C-3 will remain in their position and when the timer motor opens its cam contact III, power will be cut off from the timer motor. The oil valve will not be energized because C-5 does not make contact either. Since the timer motor stopped in an intermediate position, it is necessary to find and clear the trouble which caused the shutdown and then to operate manually the push button switch thereby energizing gas valve, ignition, burner motor and timer motor (the latter through contact II which is closed) and keep the push button switch depressed until the flame detector responds opening contact C-1. This closes contact C-2 so it is possible to release the push button without de-energizing the time motor which is then kept energized through contacts C-1 and III.

On normal operations, the timer motor will open its cam contact III but since C-2 is closed because of the response of the flame detector, it continues to be energized through contacts C-2 and I. After some predetermined time interval, it will open contact II thus disconnecting the gas valve and the ignition. It will finally re-open contact I and close simultaneously III, thus stopping itself in its initial position while the oil burner is running, and be ready for the next cycle.

As a last example of this cross section through a few representative relay control circuits, we chose the Fireye programming control by Combustion Control Corp. which is shown in schematic form in Fig. 11.

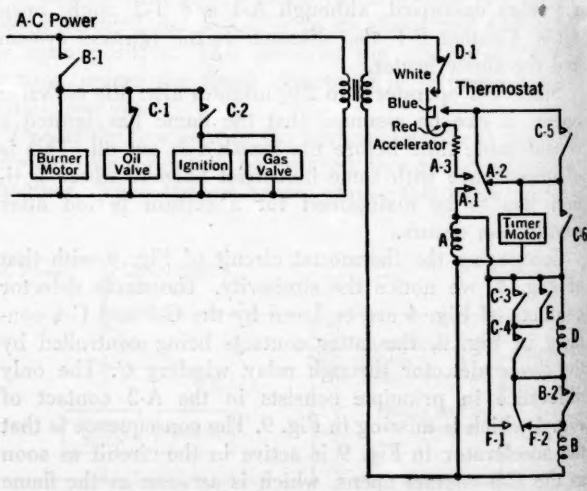


Fig. 11. Circuit of Fireye programming control.

The usual flame detector with this unit would be of the photoelectric type. Contacts F-1 and F-2 are controlled by this flame detector. An electrode for detection of the gas pilot flame might be used and contact *E* would correspond to the action of the electrode. A jumper replaces the *E* contact where no electrode system is used.

The thermostat might either be of the snap action or the series 10 type. The latter is shown in Fig. 11. When the white and blue contacts of the thermostat close, a circuit is established which can be traced from the secondary of the transformer through contact D-1, through the white and blue contacts of the thermostat, through the A-2 contact and the timer motor back to the transformer.

The timer motor now operates contacts C-1, C-2, C-3, C-4, C-5, and C-6 as follows:

C-3 closes, without consequence.

C-1 opens, keeping the circuit through the oil valve open when B-1 closes.

C-2 closes, allowing the ignition system including the gas valve to pick up as soon as B-1 opens.

C-4 closes, completing a shunt around relay *D*, since C-3 closed before.

C-5 closes, providing a circuit through the timer when A-2 opens.

C-6 closes completing a circuit through the B-relay winding which can be traced from the secondary of the transformer, through the D-1 contact; thermostat white and blue contacts, C-5, C-6, C-3, C-4, F-2, B-relay winding, and back to the transformer. The *B* relay picks up, contact B-1 closes, energizing the burner motor and the ignition system. B-2 closes.

Closure of C-6 also energizes relay winding *A*, through a circuit from C-5 through C-6 and the relay winding *A* through which it follows to the transformer secondary. As contacts A-3 and A-1 close, a holding circuit through relay winding *A* is established. Contact C-6 is no longer used because the circuit from the blue contact through contacts A-3, A-1, C-3, C-4 and F-2 (the latter is parallel with B-2) keep relay winding *B* energized.

C-6 opens without consequence, as explained.

C-3 opens. If no electrode is used for the detection of the gas pilot flame, and therefore contact *E* is replaced by a shunt, opening of C-3 has no influence. If an electrode is used, it should have responded to the pilot flame which came on when C-6 closed. In case it has not, contact *E* would still be open and the shunt around relay winding *D* would be opened when C-3 opens. This would establish a circuit through relay winding *D* to be traced from the blue contact through contacts A-3, A-1, relay winding *D*, contact B-2 (the latter is parallel with F-2), through relay winding *B*. As soon as relay winding *D* becomes energized, contact D-1 will open. Contact D-1 locks itself out mechanically and can be unlatched only manually. Contact D-1 de-energizes the entire control circuit including relay winding *B*. Consequently B-1 will open and shut off the oil burner. Assuming, however, that the electrode responded to the gas pilot flame, the normal cycle continues.

C-1 closes energizing the oil valve which opens. After this the oil flame should appear, and consequently the flame detector should cause contact F-2 to open and F-1 to close. The closed F-1 contact provides another shunt around relay winding *D*.

C-4 opens. From now on opening of F-1, i.e., flame failure during operation would immediately cause relay winding *D* to energize, and the relay *D* would pick up, locking out contact D-1 and produce a safety shutdown.

C-2 opens cutting off the ignition system.

C-5 opens disconnecting the timing motor which now is again in its initial position for the rest of the running cycle of the oil burner and will enter into action only when the next cycle begins.

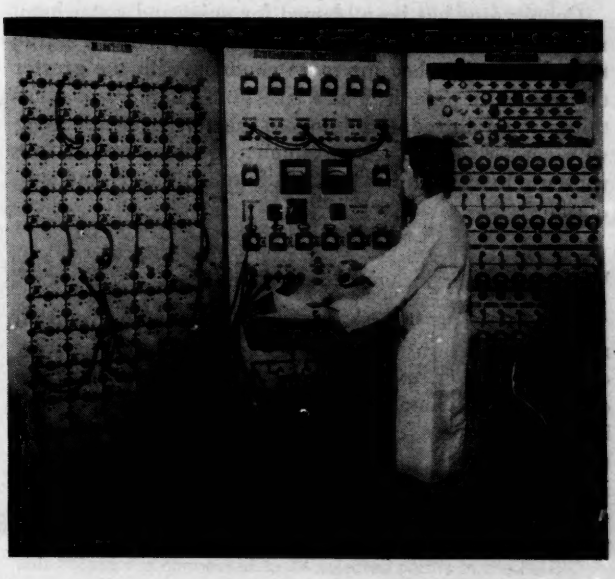
Network Analyzer Solves Pipeline Problems

Solution of problems in pipeline network installation and operation is facilitated through use of a new McIlroy pipeline network analyzer by engineers at Midwest Research Institute in Kansas City. One of only three such devices in the country, the analyzer employs a unique arrangement whereby electrical current simulates actual pipeline flow.

The left-hand panel of the analyzer is designed to represent a large variety of network layouts, comprising as many as 104 pipelines.

Master instruments in the center panel indicate directly in fluid units the flow rate in any pipeline and the pressure drop from friction between any pair of pipeline junctions. Flow rates to loads may be maintained either automatically or semi-automatically depending upon the equipment and the problem. This panel carries the controls which duplicate sources of supply, such as pumping stations and reservoirs. As many as six sources may be represented simultaneously.

The right-hand panel contains equipment to simulate 43 loads which may have any desired flow rates, and may be connected to any of the network terminals which represent pipeline junctions.



McIlroy pipeline network analyzer

Origin of Noise in Copper Pipe

T. W. REYNOLDS

The more common use of copper pipe in heating systems has brought with it a number of auxiliary causes for noise, not directly attributable to the pipe itself. Some of the causes for noise in copper pipe are described.

COMPLAINTS regarding noise or water hammer in copper pipes have become prevalent due, it is said, to the selection of sizes smaller than that recommended on the basis of research. Less friction and absence of rust accumulations in copper pipes permit the use of smaller diameter pipe for the same pressure drop, but the velocity and turbulence for a given flow will be increased. This increase may or may not create noise, depending upon the amount of increase and the particular conditions. Thus,

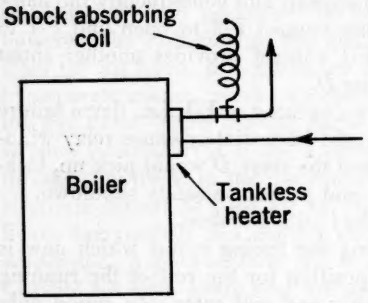


Fig. 1. An installation using a shock absorbing coil at a tankless heater.

it sometimes happens that an installation with iron or steel pipe will have no noticeable water hammer; however, when the ferrous pipe is replaced by copper pipes or tubes of smaller size, there will be complaints regarding noise.

A pressure reducing valve can be used to cut pressure and flow, although pressures in large structures cannot, as a rule, be reduced and still give adequate flow to the more distant or elevated equipment.

Copper pipe has been blamed for noise and water hammer caused by a multitude of other things. While it is true that these noises became more common with the greater use of copper pipe, it is also true that a number of other things were introduced into our heating systems along with copper pipe. As for example, circulators came into wide use to speed things, and to frequently start and stop the flow.

Water Hammer Includes Many Conditions

Over the years there has been a tendency to group all noise conditions in piping installations under the heading of water hammer. Included were not only the shock effects of true water hammer, but also noises from overheating in indirect heaters, entrained air, deformed packings, unreamed pipe and tube ends, and a host of other things intensified by increased velocities. In many cases, methods used to suspend the piping tend to amplify such noises well beyond their initial noise level, or it may be that the noise is simply due to pipes which tap against one another or the joists. Pipes of any material should not be fastened so rigidly that they transmit vibrations to the floor joints. Cushions of felt should be placed between pipe and hangers.

Copper pipe can withstand vibrations and water hammer, and soft copper pipe will resist damage from freezing.

Among the various causes of noise, cavitation is the chief offender, according to recent research. Cavitation is caused by the rapid generation of vapor bubbles in low pressure areas of pipes and this develops noise. Such areas may occur where flow is restricted by the following causes: throttled valve, corrosion deposits, worn valve or ball cock seats, and pipe burr.

By means of a sound level meter, noise caused by various kinds of fittings and combinations of such fittings have been examined. Gate valve operation compared to globe valves show gate valves are quieter when in a fully-open position, but are more noisy when used for throttling.

Noise Is Elusive

The origin of noise can be most elusive. So many things are contributing factors that attempts to eliminate it through cut and try methods are interesting and sometimes amusing. One finds an installation of pipes with 12 ft lengths of extra heavy rubber air hose at pipe ends, but with the noise still persisting; also a shock absorbing copper coil, Fig. 1, at a tankless heater which coil was of some help, at least for a time.

A water heater gives forth a rumbling noise and all sorts of changes are made until it is found that the noise is due to deposits from two anode rods in the heater. Steam bubbles at the bottom of the heater break through the deposits to make noise. The remedy in this case is more frequent cleaning out and the use of only one anode where two are not needed for water conditions.

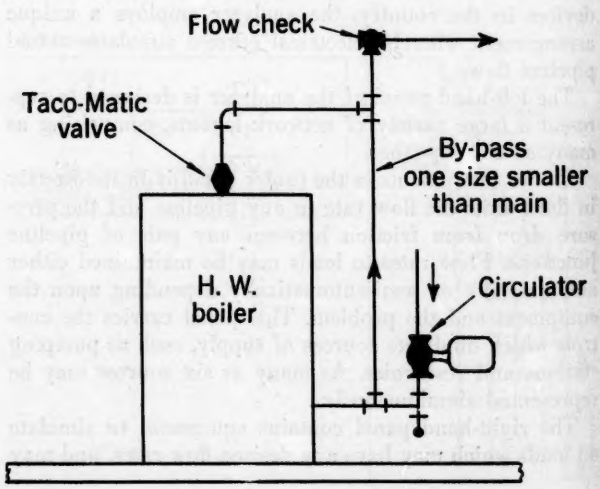


Fig. 2. Thermostatic valve provides gradual control.

In one noisy installation at a steam boiler, all of the following things were done before it was found that a tankless coil should be secured and made rigid to stop its rattling. The smokehood was sound deadened inside with asbestos board, the draft regulator relocated to prevent escape of noise, oil burner lined up and nozzles changed, firebox rebuilt, and flue baffles and boiler doors checked for rattling.

When tankless heaters are used in connection with modern small water content boilers, there is liable to be set up a condition of noise and generally unsatisfactory results. When a main is cold and the thermostat calls for heat, the circulater starts, pumps a lot of hot water into the main, and causes the pipe to expand rapidly with resulting noise. For the same temperature rise, copper pipe will expand about 50% more than will iron pipe.

The Taco-Matic valve prevents this without any need for a reverse acting control. Its gradual mixing operation prevents extremely high water temperatures from being forced into the main. It also prevents the removal of hot water from the boiler below 175F so that the proper amount of boiler hot water circulating around the coils of the tankless heater insures delivery of domestic hot water to the taps when and as desired. The Taco-Matic valve is a thermostatic device which starts to open at 185F, becomes wide open at 210F and fully closed at 175F. At this last temperature the return water is by-passed around the boiler to the flow main as in Fig. 2.

Mobile Laboratory Collects Heating Data

The mobile field laboratory, set in operation with the beginning of the '50-'51 heating season by the National Warm Air Heating and Air Conditioning Association has already demonstrated its effectiveness as a research implement.

Every Monday morning all through the past heating season, the Association's mobile laboratory backed up to the front door of someone's home. The instruments were unloaded, an armful of thermocouples and 400 pounds of recording equipment set up, and another week of intensive testing of the performance of a heating system got under way. Every Friday afternoon the thermocouples were taken down, the instruments placed back into their cases, and all the test apparatus loaded back into the truck to be moved on to another job, perhaps in another city. All travelling was done over week-ends so that no time would be lost in starting a new job each following Monday morning.

A vast amount of preliminary work had to be done before Henry Remsberg, the Association's field investigator, stepped on the starter last Fall. Every test project had to be located well in advance so that routing of the laboratory could be established. There had to be a minimum amount of travel between jobs and no back-tracking in order that the maximum number of heating systems could be tested in a single heating season. A great deal of care was used in selecting the jobs and a carefully formulated plan was followed.

The test work for the past heating season is now over. About 20 surveys were made throughout the states of Illinois, Indiana, Michigan, Ohio, and Pennsylvania and a vast amount of interesting and factual performance data accumulated that will point the way for the industry —point out bad practices and emphasize good ones—and eliminate a lot of preliminary investigation by the Research Staff at the University of Illinois.

These data are now being analyzed and put in report form by Prof. S. Konzo of the University of Illinois so that they can be placed in the hands of the interested committees as quickly as possible.

Small Pipe Systems Tested

Small pipe forced warm air systems were given the highest "rating of importance" during the past heating season. Nine such jobs were surveyed. Some of them used 1¾-inches round pipes with high temperature air and high air velocities in the ducts. There was another group that used 3½-inches round pipes in which air temperatures and velocities were considerably higher than those normally used in a conventional forced warm air heating system. Both of these might be classified as "inspirating systems" in that their operation depended upon the mixture of a substantial amount of room air with the heated air delivered to the room by the furnace.

Henry Remsberg, field engineer, and his mobile laboratory.

This recorder is connected to 24 selected points in the house.

Condensation Control in Buildings

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New designs in housing, with emphasis on insulation, weatherstripping and automatic heating equipment, have introduced new problems in the form of condensation and moisture. Some solutions have been found in research at the University of Minnesota. The following is based on a paper presented to the Building Research Advisory Board conference on condensation in buildings.

EARLY in 1937, the Engineering Experiment Station, University of Minnesota, instituted a large-scale program in cooperation with the National Mineral Wool Association. This program, which continued for four years, included both fundamental and applied studies of vapor movement through insulated walls and ceiling structures. Upon completion of this program, the Insulation Board Institute sponsored a continuation to obtain additional information including an investigation of insulated built-up roofs.

Research at the University of Minnesota has included investigations of vapor movement through both small and full scale building structures as well as many different types of materials now common to the building industry. The initial studies were confined to different types of 4 ft by 4 ft wall sections built into cubicles with controlled heat and humidity inside and out. Further investigations included a full size, three room bungalow equipped first with a flat roof followed by the construction of a gabled roof. This permitted the study of attic ventilation under varying conditions.

Unique to the large structures is the outside wall construction which permits inspection of the components during tests. The sheathing, building paper, and siding could be removed as a unit or individually to observe the movement of the moisture or frost through the wall. The rate of vapor transmitted through the small panels of material is determined by periodically weighing the frost accumulating on a removable aluminum panel located on the cold side of the special test assemblies.

Causes

Before a sound approach can be made to condensation control within structures, an understanding of the fundamental factors is necessary. These factors include (1) sources of moisture, (2) effect of inside and outside air conditions, (3) moisture migration through walls, ceilings and roofs, (4) vapor permeability of materials and (5) methods of control.

The major cause of condensation is the moisture created within a structure. Principal sources of the moisture in an average home consisting of four occupants have been determined by Purdue University and are shown in Table 1, which shows that approximately one pound of moisture per hour is introduced into the house under normal living conditions. Additional moisture is contributed by improperly protected or ventilated crawl spaces which may produce 100 pounds of water per 24 hours per 1000 sq ft of enclosed crawl space. Often overlooked, and upon which little information is available, is the ground moisture movement through unprotected or semi-protected foundations and floors. In many instances this may be a major cause where sealing of the exterior surface of the foundation has not been adequate or where concrete floors have been applied without consideration to the type of soil conditions.

TABLE 1—MOISTURE PRODUCTION BY VARIOUS DOMESTIC OPERATIONS

Operation			Pounds of Moisture
Floor mopping (per sq. ft.)			0.03
Clothes drying (per week when dried indoors)			26.40
Clothes washing (per week)			4.33
Cooking (per meal)	From Food	From Gas	
Breakfast	0.34	0.56	0.90
Lunch	0.51	0.66	1.17
Dinner	1.17	1.52	2.69
Dish washing (per meal)			
Breakfast			0.20
Lunch			0.15
Dinner			0.65
Bathing (per shower)			0.50
(per tub)			0.12
Human contribution (family of four, per hour)			0.46
Gas refrigeration (per hour)			0.12
House plants (each, per hour)			0.04
Humidifier (per hour)			2.00

S. C. Hite and J. L. Bray, Research in Home Humidity Control, Purdue University Engineering Experiment Station Bulletin. Research Series No. 106, 1948, p. 24.

A simple means of dissipating indoor moisture is by ventilation with outside air. Omitting the factor of heat loss and considering ventilation only, the air changes by infiltration within an average home are more than adequate to maintain indoor relative humidity at a safe level for an average outside wind velocity of 15 miles per hour. For an average home of 8000 cu ft provided with non-weatherstripped windows, infiltration provides 2.5

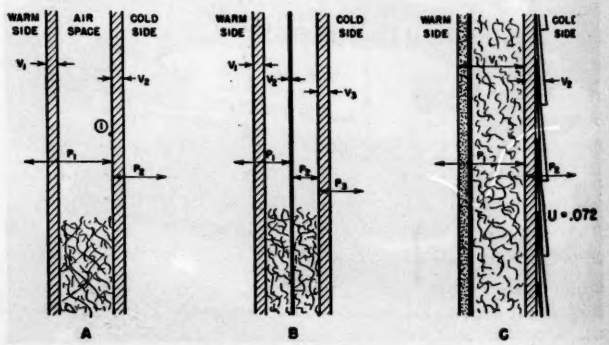

Fig. 1. Types of wall tested.

air changes per hour. Under the same conditions except that the windows are weatherstripped, only 0.5 air change per hour is provided.

For an inside condition of 70F and 40% R.H. and an outside temperature of 0F, the heat loss due to infiltration is 5400 Btu per hr for 0.5 air change per hr and 13,500 Btu per hr for 2.5 air changes. The moisture dissipated would be approximately 1.8 lb per hr for 0.5 air change and 4.5 lb for 2.5 air changes. This indicates the value of natural or mechanical ventilation in reducing the moisture conditions within a structure. The disadvantage of natural ventilation is that 15-mile wind velocities do not exist continuously and therefore cannot be depended upon to provide the necessary ventilation. Therefore, condensation difficulties may be more serious in one geographical location than another.

There have been many erroneous statements made that insulation is one of the primary causes of structural condensation. If insulation causes condensation, the principle reason is faulty design or construction. Many insulated buildings which were constructed according to good design and construction have shown no signs of condensation troubles. However, there are also many which have had moisture difficulties which have shown either faulty design or construction.

Moisture Migration

Water vapor is steam at very low pressures. Water vapor is present in air in varying quantities, which can be determined by simultaneous readings of dry bulb temperature and relative humidity. The vapor pressure exerted and the dew point temperature are dependent upon the quantity of vapor present. Vapor pressures and quantities of moisture in air at different temperatures and 100% R.H. are shown in Table 2.

TABLE 2—SATURATED VAPOR PRESSURE AT DIFFERENT TEMPERATURES

Air Temperature F.	Vapor Pressure lb per sq inch	Vapor Pressure lb per sq ft	Weight Moisture gr per cu ft Air	Weight Moisture gr per lb Air
— 20	.006	0.8	0.16	1.84
0	.018	2.6	0.47	5.50
20	.050	7.2	1.24	15.01
40	.122	17.3	2.86	36.36
60	.256	37.5	5.79	77.21
70	.363	50.40	8.05	110.2
80	.507	72.2	11.04	155.5
100	.949	137.0	19.95	300.5

The relationship between temperature and vapor pressure at constant relative humidity is significant in that there is an accelerated increase in vapor pressure per degree at higher temperatures. As will be shown later, this has an important bearing on the rate of condensation within a wall, as affected by inside and outside conditions.

The transmission of moisture through any component of a structure is dependent upon the vapor pressures on the two sides of the component and the vapor permeability of materials of which it is constructed. Assuming a simple wall as shown in Fig. 1A the rate of vapor transmission from the warm side to the inner surface of the cold side at point (1) is equal to V_1P_1 where V_1 is the permeability of the warm side material and P_1 is the vapor pressure drop from the air on the warm side to point (1). Similarly, V_2P_2 is the rate of vapor transmitted through the cold side where V_2 is the vapor permeability of the cold side material and P_2 is the vapor pressure drop from the inner surface of the cold side at point (1) to the outside air. Where $V_1P_1 = V_2P_2$, no condensation will occur on the inner surface of the cold side. Where V_1P_1 is greater than V_2P_2, condensation will accumulate in the form of frost or moisture, depending upon the temperature. Then $V_1P_1 = V_2P_2 + C$, where C is equal to the rate of accumulation of vapor in the form of moisture or frost. The temperature of the inner surface at point (1) establishes the equilibrium dew point or vapor pressure of the air space. If the rate of vapor transmitted through the warm side is sufficient to maintain a vapor pressure above the dew point temperature at point (1), condensation will form.

If a barrier is placed midway in the air space as shown in Fig. 1B, condensation may form on this plane under certain conditions. Where V_1P_1 is greater than V_2P_2 and V_2P_2 is greater than V_3P_3, then condensation will form on the center plane and on the inner surface of the cold side of the wall. Where V_2P_2 is greater than V_1P_1 and V_2P_2 is greater than V_3P_3, then condensation will form on the inner surface of the cold side of the wall. If the material (V_2) is a good vapor seal or has a low vapor permeability and the dew point temperature of inside air is below that of the vapor in the air space toward the warm side of the center plane, condensation will form on the warm side but none on the inner surface of the cold side of the wall. The same principles would apply for walls having fiber insulation, as for those with an air space, as the resistance of fiber insulation to vapor flow is generally very low.

The effect of outside temperature only on the vapor pressure drop was studied for a single type of wall consisting of metal lath and plaster, no vapor barrier, full thick mineral wool insulation, wood sheathing, building paper and siding as shown in Fig. 1C. The overall U value is .072. As shown in Table 3, vapor pressure drop (P_1) from the warm side to the inner surface of the sheathing and the vapor pressure drop (P_2) from the warm side of the sheathing to the outside air were determined for different outside saturated air temperatures and for inside air conditions of 70F and 40% R.H. in each case. Vapor permeability of the materials, for all practical purposes, remained constant. The warm side vapor pressure drop P_1 increases as the outside temperature decreases, whereas the cold side vapor pressure drop P_2 decreases. Thus, it is evident that the rate of vapor entering the wall increases with a decrease in outside temperature and vapor pressure. As the outside temperature is lowered from 20F to −20F, the rate of condensation may be two to seven times that at 20F. At −20F, the rate of condensation is approximately three times the rate at

TABLE 3—EFFECT OF OUTSIDE AIR TEMPERATURES ON THE CONDENSATION RATE WITHIN AN INSULATED WALL
(Inside Air 70F, 40% R. H.)

Temperature, F		Vapor Pressure—Inches Hg					
Outside Air	Sheathing	Inside Air	Sheathing	Outside Air	Difference Warm Side, P_1	Difference Cold Side, P_2	Ratio $\frac{P_1}{P_2}$
20	26	.296	.137	.051	.159	.086	1.85
10	19	.296	.098	.032	.198	.062	3.20
0	11	.296	.067	.019	.229	.047	4.86
—10	2	.296	.042	.011	.254	.031	8.20
—20	—6	.296	.027	.006	.269	.021	12.80

TABLE 4—EFFECT OF INSIDE RELATIVE HUMIDITY ON THE CONDENSATION RATE WITHIN AN INSULATED WALL
(Inside Air 70F, Outside Air 0F, Sheathing, 11F)

Humidity Inside Air, % RH	Vapor Pressure—Inches Hg					Ratio, $\frac{P_1}{P_2}$
	Inside Air	Sheathing	Outside Air	Difference Warm Side, P_1	Difference Cold Side, P_2	
20	.147	.067	.019	.080	.047	1.7
30	.222	.067	.019	.155	.047	3.3
40	.296	.067	.019	.229	.047	4.9
50	.369	.067	.019	.302	.047	6.4
60	.443	.067	.019	.376	.047	8.0

0F, assuming constant outside relative humidity at 100%.

The effect of inside relative humidity at 70F air temperature for a constant outside air temperature of 0F on the rate of condensation within the same type of wall was also determined as shown in Table 4. In this case, the warm side vapor pressure drop (P_1) increases with inside relative humidity; however, on the cold side the vapor pressure drop (P_2) remains constant due to sheathing temperature and outside air temperature remaining constant. The condensation rate increases approximately five times for an increase in inside relative humidity from 20 to 60%. Likewise, increasing the inside relative humidity from 30 to 50% approximately doubles the rate of condensation.

Other factors which have an additional effect upon the rate and quantity of frost accumulation are: length of time exposed to conditions causing condensation; variable outside temperatures; sun effect in raising the temperature of the exterior parts of the wall; variable inside conditions and type of construction.

Vapor Permeability

In addition to the application of approved methods of design in construction, it is necessary to apply knowledge of the vapor permeability of the common materials used. Most construction materials have a low resistance to vapor transmission. Others have high resistance and are usually classified as vapor barriers. The selection and correct installation of the right combination of materials will effectively control condensation and eliminate most of the difficulties.

Materials classified as vapor barriers are those which have a permeability rate not exceeding 1.25 grains per (sq ft) (hr) (inch of mercury) or 1.25 perms. One perm equals one grain per (sq ft) (hr) (inch H_g). A list of the most common types of vapor barriers and their vapor permeability rates are shown in Table 5.

TABLE 5—PERMEABILITY OF VAPOR MEMBRANES

Type of Membrane	Perms*
Asphalt impregnated and surface coated glossy sheathing paper	0.36 to 0.64
Duplex paper 30-30-30	0.57 to 0.98
Duplex paper 30-60-30	0.57
Aluminum foil	0.18 to 0.21
Dull surface coated cloth used as wall paper	0.85 to 1.20
Wall linoleum	0.28 to 0.56
Glossy surface coated cloth	0.85 to 0.97

*Grains per (square foot) (hour) (inch Mercury)

The effect of different types of paint on reducing the vapor permeability of a material was tested. Paints were applied to ¾-inch plaster and ⅜-inch plaster board. The permeability rates for the unpainted surfaces are 8.75 perms for the plaster and 34.34 perms for the plaster board. The paints provided satisfactory protection against vapor movements in each case with the exception of water emulsion paint. As a general rule, a primer or paint having a high varnish content may be considered a good vapor barrier. Varnish itself provides a good barrier. The rubber base paints are also good vapor barriers if applied correctly. Paint must provide a continuous, unbroken surface in order to be a satisfactory vapor barrier. In practice, it is recommended that two coats be applied to insure a continuous surface coating. For example, for both the aluminum and rubber base paints applied as a single coat to gypsum plaster, the rate of vapor transmission exceeded the limits of a satisfactory barrier. When two coats were applied, this value was considerably reduced. When applied to the plaster board, two coats of flat and one of aluminum paint provided a good barrier of 0.25 perm. Some surfaces absorb more paint than others and therefore must be primed so that the next coat of paint will result in a uniform unbroken finish. Past investigations have shown that water emulsion paints, linseed oil, and similar vehicles do not provide a good vapor barrier. Paint, to be an effective vapor barrier, is dependent mainly upon the vehicle and not the pigment, although the pigment in some cases may add a small amount of resistance.

Permeable Materials Commonly Used in Construction

Many materials used as interior finishes are permeable to vapor transmission. A list of these materials and their vapor permeance is shown in Table 6.

TABLE 6—VAPOR PERMEABILITY OF BUILDING MATERIALS

Type of Material	Perms*
¾ inch plaster on metal lath	13.3 to 14.8
⅜ inch plaster board	34.4
¾ inch plaster on ⅜ inch plaster board	9.95
½ inch uncoated fiber board insulation	43.7 to 90.1
½ inch asphalt coated fiber board insulation	0.28
⅜ inch plywood	0.80
25/32 inch fiber board insulating sheathing	48.58 to 89.29
1 inch cork	6.2 to 20.1
3⅝ inch mineral fiber insulation	17.8 to 29.1
¾ inch plaster on metal lath and 3⅝ inch mineral fiber insulation	8.75

*Grains per (square foot) (hour) (inch Mercury)

In general, all materials have a high permeability rate except where they are specially treated. In the design of any wall structure, serious consideration must be given to provide the additional resistance to prevent the movement of vapor into the wall to prevent condensation difficulties.

Walls

To illustrate the effectiveness of an acceptable vapor barrier versus no vapor barrier in reducing condensation within walls, a typical insulated wall has been selected as shown in Fig. 2. It consists of ¾ inch metal lath and plaster, 3⅝ inch mineral fiber insulation, wood sheathing, building paper and siding. The analysis of the vapor movement through the wall is based upon an inside air condition of 70F and 50% R.H. and an outside air condition of −20F and 50% R.H. The quantity of vapor transmitted from the inside air to the inside surface of

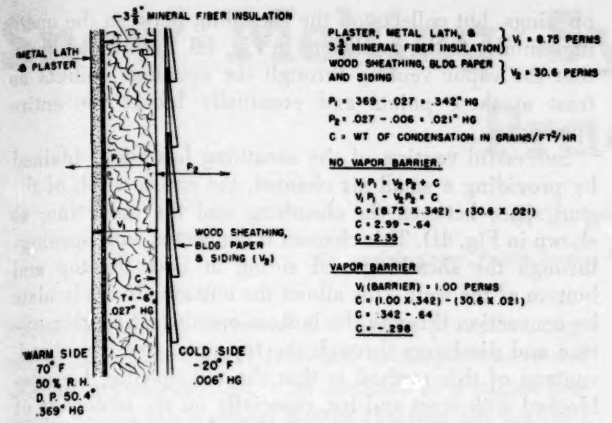
3⅝" MINERAL FIBER INSULATION
METAL LATH & PLASTER
WOOD SHEATHING, BLDG. PAPER & SIDING (V₂)
WARM SIDE 70° F 50% R.H. D.P. 50.4° .369" HG
COLD SIDE -20° F .006" HG
PLASTER, METAL LATH, & 3⅝" MINERAL FIBER INSULATION } V₁ = 8.75 PERMS
WOOD SHEATHING, BLDG. PAPER AND SIDING } V₂ = 30.6 PERMS
P₁ = 369 - .027 = .342" HG
P₂ = .027 - .006 = .021" HG
C = WT OF CONDENSATION IN GRAINS/FT²/HR
NO VAPOR BARRIER
V₁P₁ = V₂P₂ + C
V₁P₁ - V₂P₂ = C
C = (8.75 X .342) - (30.6 X .021)
C = 2.99 - .64
C = 2.35
VAPOR BARRIER
V₁ (BARRIER) = 1.00 PERMS
C = (1.00 X .342) - (30.6 X .021)
C = .342 - .64
C = -.298

Fig. 2. Condensation control analysis.

the sheathing may be expressed as V_1P_1, where V_1 is equal to 8.75 perms for the metal lath and plaster and the 3⅝ inch mineral fiber insulation. The temperature of the inside surface of the sheathing is −6.0F, which is below the dew point temperature of 50.4F for the inside air. Thus a vapor pressure drop exists from the inside air to the inside surface of the sheathing which is expressed as P_1 and is equal to .342 inch of mercury. The inside surface of the sheathing is the first point of high resistance because of its low permeability rate. The vapor transmitted through the outer wall section is equal to V_2P_2, where V_2 is equal to 30.6 perms for the sheathing, building paper and siding. The vapor pressure drop P_2 is equal to 0.021 inch of mercury. The permeability of the sheathing was found through a series of laboratory tests conducted upon a similar wall of good construction and with the siding normally applied and having two coats of outside white paint. Obviously, the permeance of this section may vary considerably, depending upon workmanship and the type of materials used. Crack openings between the sheathing and between the siding as well as at the upper and lower 2 by 4 plates will have a considerable effect upon the permeability rate of this section.

The vapor movement from the inside air to the outside air may be expressed as $V_1P_1 = V_2P_2$ providing no condensation takes place at the interior surface of the sheathing. If condensation forms on the sheathing, $V_1P_1 = V_2P_2 + C$ where C is the rate of condensation accumulating in grains per square foot per hour.

Referring again to Fig. 2, the condensation rate that may be expected within a wall with and without a vapor barrier has been calculated. For a wall with no vapor barrier, the calculated condensation rate is equal to 2.35 gr. per (sq ft) (hr). Although the resistance of the materials on the warm side is greater than that on the cold side, the vapor pressure drop across the inner section is approximately 17 times greater than across the outer section thereby permitting more vapor to enter the wall than that which can be vented out through the exterior parts. Where a vapor barrier having a value of 1.00 perm is used the resistance to vapor movement on the warm side is greater than that on the cold side and therefore no condensation is formed. Thus it is apparent that the vapor permeability of a barrier which is to be used in any construction is dependent upon the vapor pressure drop through the wall and the resistance of the exterior part of the wall to the transmission of this vapor. All vapor barriers should be installed as close to the warm side as possible.

Roofing

Greater precautions must be taken in the design of roofs where no ventilation is provided. Laboratory tests have shown that the permeability of 2- to 4-ply built-up roofing is 0.0 perms. Thus it is mandatory on insulated roofs that a vapor seal be installed below the insulation which is equally as resitsant to vapor movement as the built-up roofing. Fig. 3 shows an insulated built-up roof with a steel, wood and concrete deck. Applying the same principles as discussed under vapor movement through walls, then $V_1P_1 = V_2P_2 + C$. However, V_2 has been found to be equal to 0.0 perms. Then $V_1P_1 = C$, where C is the rate of vapor that is transmitted depending upon V_1 and P_1. A two-ply solidly mopped vapor seal course has a permeability rate equal to 0.0 perms. Thus, no condensation will take place if such a barrier is installed.

For a concrete deck, a vapor barrier is required irrespective of the inside conditions. Concrete contains large quantities of moisture when initially poured. Until the concrete is completely cured, the moisture may enter the insulation and condense at the underside of the roofing during exposure to low temperatures. To prevent such a condition, a vapor seal course is recommended on all concrete or similar decks prior to the installation of the insulation and the roofing.

Research studies during the past four years at the University of Minnesota have shown that moisture entering an insulated roof structure causes blisters between the plies of the roof and eventual failure. As shown in Fig. 3, surface temperatures may attain 150F due to solar radiation for air temperatures of 80F. Any moisture trapped within an insulated built-up roof or permitted to enter from the warm side has no means of venting and because of its exposure to the wide range of temperatures, expansion of this vapor takes place. The expansion of air and vapor within a built-up roof may attain pressures as high as five pounds per square inch if precautions are not taken to eliminate moisture and to solidly mop and obtain good adhesion between the various plies of felt. The importance of avoiding moisture during the construction of a roof due to inclement weather or improper storage of materials cannot be over-emphasized.

Ventilation of Walls and Roofs

During the period when condensation is taking place in winter, the inside and outside air conditions set up a temperature and vapor pressure gradient for the move-

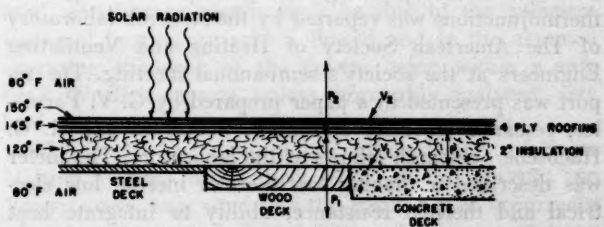

Fig. 3. Built-up roofing. Where V_2 = 0.0 perms, V_1 should also be 0.0 to prevent condensation.

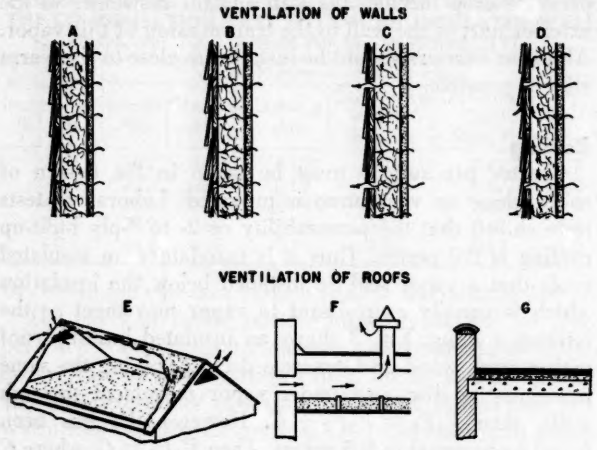

Fig. 4. Arrangements for wall and roof ventilation.

ment of vapor from the inside to the exterior. The purpose of venting under these conditions is to reduce the resistance of the outer section. A typical insulated wall section without a barrier has been selected, as shown in Fig. 4, to illustrate the movement of vapor under different conditions of venting. In Fig. 4A, the vapor movement is from the inside air to the sheathing where it may accumulate as previously discussed. Experience has shown that the outer section of this type of wall does not provide any significant quantity of ventilation for reducing the accumulation of moisture on the interior surface of the sheathing without some type of added ventilation.

In Fig. 4B, the siding only has been lifted to provide ventilation. In this case there may be only a slight reduction in the resistance of exterior section, depending upon the crack openings between the sheathing. Condensation, however, will form on the interior surface of the sheathing between the crack openings due to its surface temperature being below the dew point temperature of the air within the stud space. If large cracks occur directly behind an opening in the siding, ice or frost may accumulate in such quantity as to block the openings.

In Fig. 4C, vent openings are provided at several points directly through the sheathing and siding. Although this type of venting is impractical, it illustrates the mechanics of vapor movement and the effect of different types of venting. In this case, the vapor vents only through the openings, but collects on the sheathing between the openings similar to the conditions in Fig. 4B. Tests have shown that the vapor venting through the openings collects as frost at these points and eventually blocks the entire opening.

Successful venting of the sheathing has been obtained by providing a small air channel, the entire width of the stud space between the sheathing and the insulation, as shown in Fig. 4D. This channel is connected with openings through the sheathing and siding at both the top and bottom of the wall. This allows the outside air to circulate by convection through the bottom openings, absorb moisture and discharge through the top openings. The disadvantage of this method is that the top opening becomes blocked with frost and ice, especially on the underside of the siding. Successful venting of walls is difficult during the period when condensation is taking place and is not a satisfactory substitute for a vapor barrier on the warm side of the wall.

As shown in Fig. 4E and 4F, ventilation of attic spaces or suspended ceilings is successful providing that the opening are large enough to supply the quantity of air necessary to dissipate the vapor. It is important, however, that all parts of these spaces are vented to eliminate spotty conditions of frost accumulation. Net openings equivalent to ½ square inch per square foot of ceiling are recommended where no vapor barriers are used in the ceilings. These openings should be distributed to provide cross-ventilation throughout the entire space. The HHFA recommends one square foot of net opening for 300 square feet of ceiling area which is approximately the same as the value given above. This type of ventilation will not prevent condensation underneath attic floors or similar applications, as in such instances the resistance of the floor causes frost to accumulate on the underside. Either the floor should be removed or a vapor barrier added on the warm side. However, venting will assist in dissipating the vapor which escapes through the crack openings in the flooring and other parts of the structure.

With regard to built-up insulated roofs, venting during periods conducive to moisture is difficult as shown in Fig. 4G. The permeability of built-up roofing is 0.0 perms and therefore permits no venting. Under such conditions it is necessary to install a vapor seal course having the same permeability as the roofing in order to eliminate the problem of condensation.

Low-Inertia, Low-Resistance Heat Flow Meter Developed

The performance of a low-inertia, low-resistance heat flow meter incorporating the principle of large-area thermojunctions was reported by the research laboratory of The American Society of Heating and Ventilating Engineers at the society's semi-annual meeting. The report was presented in a paper prepared by G. V. Parmelee, research associate and L. F. Schutrum and R. G. Huebscher, research fellows at the laboratory. The meter was described as having low thermal inertia, low electrical and thermal resistance, ability to integrate heat flow over the entire area of the meter, adaptability as to response, shape and size, and ease of construction.

The principle of operation of this heat flow meter is the measurement of the temperature difference between opposite sides of a thermal resistance layer. The principal feature of the construction is the use of thermocouple chains made from copper-constantan foil or ribbon. This was made by welding a bar of constantan to a bar of copper and rolling it into a thin ribbon of which half the width was copper and half constantan. The thermocouple chains were woven in basket-weave fashion over and under strips of material constituting the thermal resistance layer. Notches cut into the ribbon form junctions, and the woven assembly is cemented between aluminum foil.

Snow Melting System Practice and Design

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Present practice is reviewed and design procedure suggested based on current technical accomplishments and weather experience. This is an abstract of a paper presented before the National District Heating Association's 1952 annual meeting.

IMPORTANT and interesting data concerning snow melting systems were obtained as the result of a questionnaire sent to special committee members of the National District Heating Association. These indicate current practices and trends in operation and design as follows:

(1) Nearly 70% of the total snow melting installations reported on district heating systems have been made within the last two years, or are in process of construction; A. M. Byers Co., Pittsburgh, Pa., reported that of a total of 260 installations, 25% were made within the last two years.

(2) About 10% of all installations are for areas of 6,000 sq ft or more. Of these larger systems, 40% were installed during the last two years.

(3) Use of steam over an average season of snowfall will represent 100 to 200 hours of maximum demand in pounds of steam per hour, provided that the system is not operated between periods of snowfall.

(4) Steam demand is normally in the range of 0.2 to 0.4 lb of steam per square foot of heated surface while melting snow, and is normally one-fourth to one-third of the maximum load during periods between snowfall if the system is operated continuously.

(5) Current costs of installation are reported in the range of $2 to $3 per sq ft of heated surface, exclusive of paving and sub-surface insulation, with labor being the most variable factor.

(6) At an assumed average temperature of 26F during snowfall, the reported coincidence factors (maximum system demand vs system demand at 26F) is 0.74 to 0.88.

There are a few systems in service which utilize returned condensate or direct steam in the heating coils. A number of small snow melting systems and the largest system in operation, installed in the past few years, are using oil as the heat transfer medium, and this may indicate a trend. The higher cost of larger heat exchangers and the required larger capacities of circulating equipment due to the relatively low heat capacity of the heat transfer oil at normal operating temperatures compared with the glycol base types of anti-freeze solutions, are offset by the lower first cost of the oil, its expected stability, and by freedom from corrosion.

Between such extremes as systems operated continuously throughout the heating season or the ones started after snow begins to fall, there are many types and combination of controls in use. The most popular method is an aquastat to control the maximum solution temperature and a manually operated switch to start the pump when snow is anticipated. There is increasing interest in the use of slab temperature control with an auxiliary control to limit solution temperature.

Unless means are installed to reduce the quick pick-up peak in starting the snow melting system, where preheating is not used the quick pick-up load may be as much as 300% of the normal melting load. This indicates the desirability of starting the snow melting system well in advance of snowfall or operating it continuously over the period of the year when snowfall occurs. Systems designed to shut off automatically when snowfall ends may require controls to dry the surface and to prevent the formation of ice when this snowfall is followed by a sharp drop in air temperature, or high wind, or both. There should be sufficient heating capacity to offset the rapid loss heat above pipes under these conditions without risking possible damage to concrete or that caused by excessive mechanical stresses in piping coils or grids.

Design Factors

The usual operating temperatures reported are in the range of 120 to 140F with temperature drops varying from 20 to 40F. The usual average design solution temperature, as reported, is 160F. Although the designer may be tempted to greatly increase the design allowance in Btu per square foot of heated surface for areas where heavy snowfall occurs frequently so that there may be satisfactory operation for most of the weather conditions likely to be experienced, the result may be a system larger than necessary to meet usual conditions with an unnecessary installation cost.

The accepted practice is to base the design of snow melting systems on a mean temperature of 26F during snowfall, an average density of snow of 6 lb per cu ft, and an assumed melting rate of one inch of snow per hour. Some systems in northern sections have been designed for greater snow melting rates. However, snow does not actually have this density. Where this figure is used, satisfactory results may be due to the sufficient marginal heating capacity followed and to the assumed operating efficiency of the system being within a safe limit. Weather reports, unless thoroughly analyzed, may lead to erroneous conclusions.

William P. Chapman in his article Design of Snow Melting Systems in the April, 1952 issue of HEATING AND VENTILATING, suggested that the frequency of occurrence of various quantities of precipitation during temperatures lower than 32F over consecutive hourly periods and over

a period of years be evaluated in terms of water equivalent in inches per hour as a basis of snow melting system design. One inch of water equivalent is equal to 5.2 lb per hr per sq ft. This would eliminate the controversial density of snow factor.

Fig. 1 shows snowfall at Denver, Col., November 2, 3 and 4, 1946 for a period of 70 consecutive hours, an unusually severe storm of long duration. Precipitation did not exceed 0.09 inch over any hour. Using the accepted equivalent of 10 inches of snow to one inch of precipitation, would give a top snowfall rate of 0.9 inch per hour. The mean temperature over the 70 hours was 26F. With the assumed design density of snow of 6 lb per cu ft, the curve shown by the short dash lines represents computed snowfall at this density. Actual densities of snow over periods reported are 3.84, 4.5 and 4.4 lb per cu ft with the average for this period being 4.167. Snowfall greatly exceeded the 10 to 1 ratio. Respectively, for the three periods it was 16.25 to 1, 13.87 to 1, and 14.15 to 1 or an average of 15 to 1. Ratios of 15 to 20 inches of snow to one inch of precipitation are not unusual. High winds caused the drifting of snow and there was almost an absence of sunshine during the first 44 hours of this storm. High wind velocity accompanying snow is an important characteristic which has received relatively little recognition in the design of snow melting systems. Snow may fall at any temperature below 32F, and since the amount of water vapor that the air can hold decreases as the air temperature decreases, the rate of snowfall is relatively less at low temperatures.

For better design, it is suggested that less attention be paid to melting capability and snow density, and (1) more recognition be given to the maintenance of an approximate surface temperature of 34F under any and all design weather conditions with consideration of precipitation. wind velocity, air temperature and relative humidity; (2) provide ample radiation with relatively close spacing of pipes; (3) raise the temperature of the circulating medium within reasonable limits, preferably automatically, during the periods when snow is falling and when it is necessary to compensate for the rapid loss of heat due to wind and low temperatures following snowfall. Closer spacing of pipes adjacent to non-heated areas is suggested to melt the snow carried over by pedestrians to the heated surfaces.

Unless subs-lab insulation is used, as much as 40% allowance for back losses should be provided where the system is not to be operated continuously. In addition to the heat required to melt the snow and the heat allowance for back losses, Chapman has suggested that the often neglected heat of vaporization and the convection and radiation losses should be evaluated for the climatological conditions selected as the basis for design.

By evaluating all the variable factors which make up the selected design weather conditions, the designer will have some assurance that the system will be neither under nor over-designed, which might be the case if the only factors considered were the heat of fusion and an arbitrary allowance for heat losses.

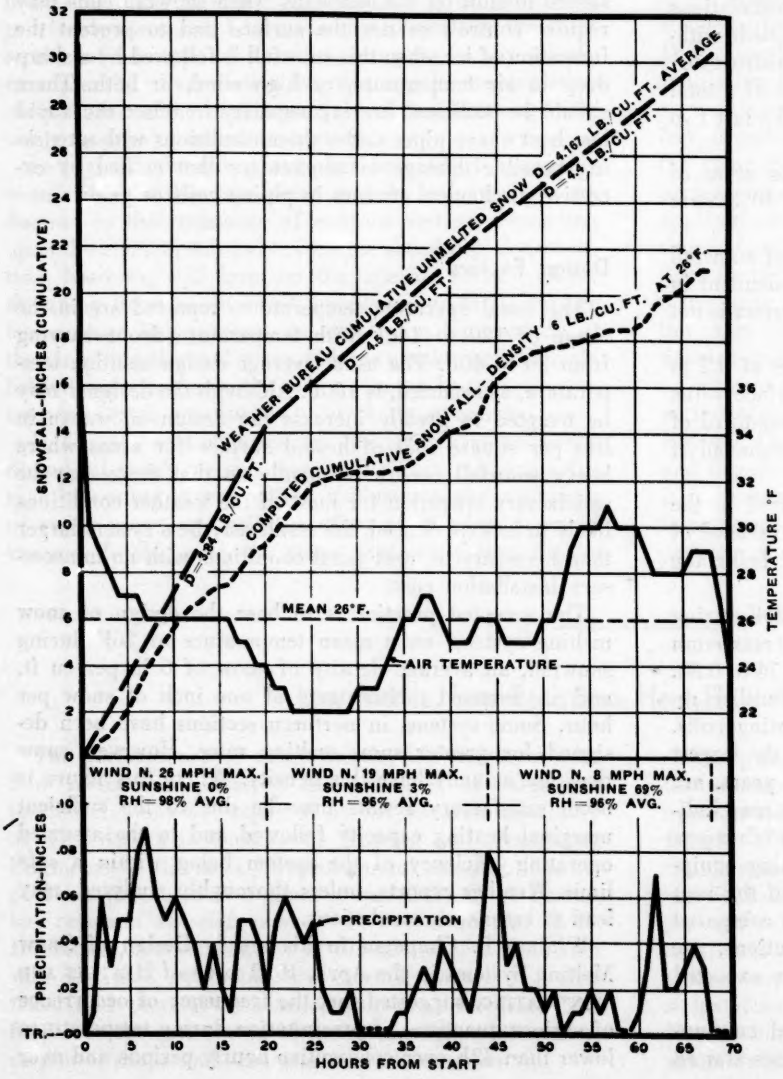


Fig. 1. Snowfall at Denver, Col., during a 70-hour storm on November 2, 3 and 4, 1946.

Operation, Application and Effectiveness of

Dust Collection Equipment

JOHN M. KANE

Manager, Dust Control Division, American Air Filter Co., Inc., Louisville, Ky.

Practical information to help the engineer select the type of dust collector equipment most suitable for a specific application.

AIR cleaning devices are usually divided into (1) air filters and (2) dust collectors, based on the quantity of material to be removed from the air stream. Air filters remove the light concentration of solids found in outside air and in general air supply systems used for heating, ventilation, and air conditioning. Dust loadings are usually 1 gr (grain) per 1,000 cu ft or less and seldom will exceed 4 gr per 1,000 cu ft. Dust collectors are designed for the very much heavier loads from industrial processes where the air or gas to be cleaned originates in local exhaust systems or process stack gas effluents. Concentrations will range from 0.1 to 20 gr or more per cu ft. Note that loadings, therefore, are some 100 to 20,000 times the loadings for which air filters are designed. Where the air stream is used to convey materials such as in low pressure conveying systems, pulverizer circuits and secondary dust circuits of dust collectors, the dust concentrations can range up to 500 gr per cu ft.

Dust collecting devices are usually installed for one or more of the following reasons:

Prevent Damage or Nuisance to Property. Process dust discharged to the atmosphere from stacks not equipped with effective air cleaning devices permits the coarser particles to settle in the general area of the stack. Such settlement can be a nuisance to neighborhood property and many times actually cause damage from oxidation or chemical attack. Finer particles stay in suspension for prolonged periods of time contributing to the air pollution problems of the community.

The foundry cupola and the lime hydrator are examples of coarse emissions in quantities such that settled materials on the plant roofs cause endless maintenance in material removal and roof repair.

The aggregate dryer, the cement kiln, and the stoker-fired or pulverized fuel boiler, discharge loadings that settle on porches, ledges, and laundry over an extended area from the point of emission.

Exhaust of ferrous grinding, heat treat furnaces, plating and caustic tanks, can discharge materials that damage the finish of automobiles.

Sub micron particles, such as zinc oxide and ferrous oxide from melting operations, are typical of the stack effluents that tend to stay in suspension for long periods causing (1) the smogs that reduce visibility and (2) shut out sunlight where meteorological conditions prevent their dispersion to the conisphere.

Prevent Re-entry of Contaminants to Workroom Air. Air cleaning equipment will prevent the re-entry of contaminants from exhaust systems back to the workroom air. Without collectors, discharged contaminants can be

swirled from exhaust stacks back to the workroom through open windows and doors, or they can be picked up by fresh air supply and makeup air systems.

Reclaim Usable Material. Salvagable material collected by air cleaning equipment is a major reason for dust collector installation. In some cases like the manufacture of carbon black, the sintering and roasting of lead ores, and the pulverizing of chemicals, the dust collector is an importance piece of equipment essential to the efficient operation of the manufacturing process.

Many fine materials are conveyed by air through duct systems using the air stream as the transport media. Collectors are an essential element in such systems which are used extensively in the textile, grain, food processing, and chemical industries.

In other groups of operations such as collection of flour dust in bakeries, brass grinding dust in metal finishing, ore dust from crushing and milling, lime dust from kilns, and sugar dust from dryers and coolers, cost of air cleaning equipment will be paid for from salvaged material even though the basic reason for the installation is the prevention of a nuisance problem to the plant and its neighborhood.

Reduce Fire or Explosion Hazards. Collection of fine dust, especially from organic materials, can eliminate the fire hazards introduced by settled material discharged from exhaust systems controlling such items. Collectors removing coal dust, wood sander dust, grain dust, and oil fumes are examples.

Danger from fine explosive dusts can also be reduced by using a dust collector of a design that will remove and store such materials safely. Wet type dust collectors have been used extensively for this purpose in the manufacture of explosives and the collection of magnesium dusts.

Permit Recirculation of Cleaned Air to Working Space or Process. With the rapid expansion in the use of exhaust systems, quantities of air involved in expanded ventilation usage has taxed heating facilities and retarded flexibility of dust-producing plant equipment relocation. The question of recirculation of air from dust collectors is still a controversial subject which warrants the detailed discussion that is included as a separate section in this presentation.

Selection of Dust Collecting Equipment

Dust collection equipment is available in numerous designs utilizing a number of principles, and featuring wide variation in effectiveness, first cost, operating and maintenance cost, space, arrangement, and materials of construction. Consultation with the equipment manufacturer is the recommended procedure in selecting a collector for any problem where extensive previous plant experience on that specific dust problem is not available. From Fig. 1, it can be noted that for certain particle sizes, performance of different collector types overlap. Factors that will influence equipment selection will include:

Concentration and Particle Size of Contaminant. Contaminants in exhaust systems cover an extreme range in loadings and particle sizes. Concentration can range from 0.1 to 20.0 or more grains per cubic foot. In low pressure conveying systems, usual concentrations will be as high as 150 gr per cu ft. Mean particle size of industrial contaminants range from 0.5 to 100 or more microns. Deviation from mean size (the range of over and under the mean) will also vary with the material. Some indication of the mean particle size and deviation of typical contaminants has been included in the composite chart, Fig. 1.

Degree of Collection Required. A basic decision must be made concerning the type of collector needed to do a satisfactory cleaning job for the specific problem under consideration. Evaluation will consider the need for high efficiency high cost equipment like electrostatic precipitators, high efficiency moderate cost equipment like fabric or wet collector units, and the lower cost primary units like the dry centrifugal group. If either of the first two groups are indicated, the question of combination with primary collectors should be weighed.

Degree of collection will depend on plant location, comparison of quantities of material released to atmosphere with different types of collection, nature of contaminant and its salvage value, or its potential as a health hazard or ability to damage property. For most contaminants, a plant located so that it is remote from other industries or residential areas need not select equipment with as high a degree of removal as a plant not so fortunately located. Even for such remote locations, damage to farms or contribution to air pollution problems of remote cities can indicate the need and the importance for effective collection equipment. Many an industry originally away from residential areas failed to anticipate the influx of residential building prompted by the plant itself. Such errors have accounted for the purchase of improved dust collecting devices by many a cement mill, coal mine, and other remotely located plants.

With the emphasis on public nuisance and air pollution from stack effluents, a plant can now expect the same public criticism for excessive emissions whether located in a heavy industry section of a city or in an area closer to residential zones.

Quantity of escapement (mass rate of emission) will also influence equipment. For a given concentration, the larger the exhaust volume, the greater the need for better collection equipment. Large central steam generating stations will select high efficiency electric precipitators for their pulverized coal boiler stacks while an industrial pulverized fuel boiler could use lower efficiency dry centrifugals and still discharge to atmosphere only a fraction of the pounds escaping in the much larger gas volumes of the central station stacks. For a given dust loading, a collector of 50% efficiency cleaning a volume of 1,000 cfm would not discharge any more pounds of material to the atmosphere (although the mean particle size of discharge dust would be larger) than a collector with 90% efficiency cleaning a volume of 5,000 cfm (mean particle size, however, would be much smaller).

One safe recommendation in equipment selection can be summed up as: Select the collector that will allow the least possible amount of contaminant to escape and still be reasonable in first cost and maintenance. For some applications, even the question of reasonable cost and reasonable maintenance must be sacrificed to meet established standards for air pollution control or to prevent damage to health or property.

It must be remembered that visibility of an effluent

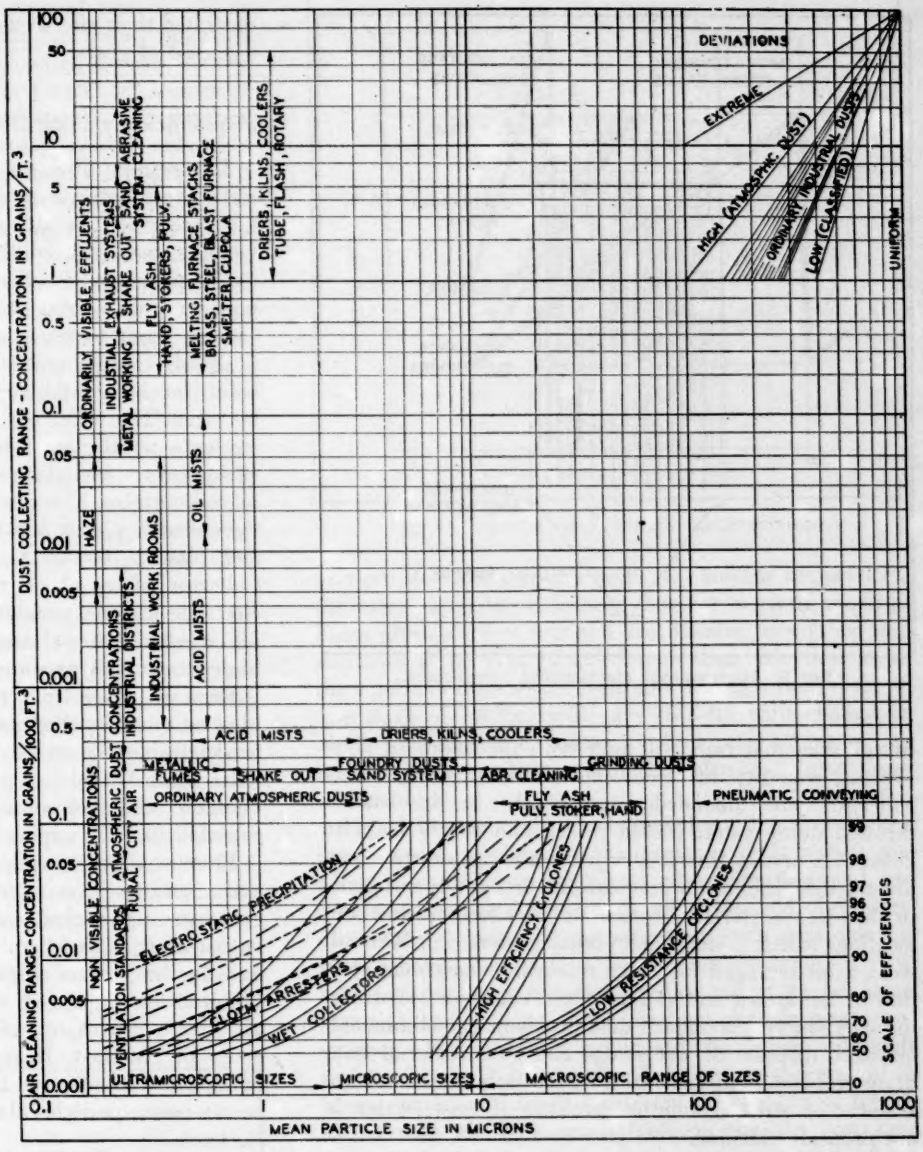


Fig. 1. Range of particle sizes, concentration and collector performance from information compiled by S. Sylvan. © American Air Filter Co. Inc.

will be a function of the light reflecting surface area of the escaping material. Surface area per pounds increases roughly as the square of particle size which means that the removal of 80 to 90% of a dust load can remove the coarse particles without altering the stack discharge appearance.

It is also difficult to compare efficiency claims of manufacturers in a given group of collectors. The absence of a standard method of small micron particle measurement can result in a variation in performance reported dependent on measurement equipment used.

Characteristics of Air or Gas Stream. The characteristics of the carrier gas stream can have a marked bearing on equipment selection. High temperature gas streams exceeding 130F will prevent the use of standard cotton media in fabric collectors; presence of steam or condensation of water vapor will cause packing and plugging of air or dust passages in fabric and dry centrifugal collectors; chemical composition can attack fabric or metal in dry collectors, and cause extremely corrosive conditions when mixed with water in wet type collectors.

Characteristics of Contaminant. The contaminant characteristics will also affect equipment selection. Chemical composition can cause attack on collector elements or the corrosion in wet type collectors. Sticky materials like metallic buffing dust impregnated with buffing compounds can adhere to collector elements plugging collector passages. Linty materials like dust from the textile opener, picker, napper will adhere to certain types of collector surfaces or elements. Abrasiveness of many materials in moderate to heavy concentrations like dust from sand blasting will cause rapid wear particularly on dry type centrifugal collectors. Particle size and shape will rule out certain collector designs. The large size of some woodworking splinters and shavings, plus the refuse from floor sweeps, could plug the collector air or dust passages of some designs. The parachute shape of particles like the "bees wings" from grain will "float" through centrifugal collectors due to their velocity of fall being slower than much smaller spherical particles of the same specific gravity. Combustible nature of many finely divided materials will influence selection of safe types of collectors for such products.

Method of Disposal. Methods of removal and disposal

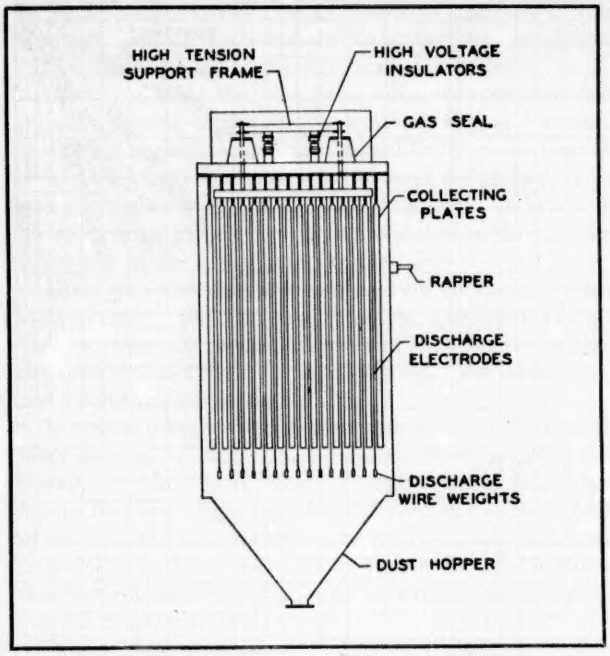


Fig. 2. High voltage electrostatic precipitator.

of collected materials will vary with the material, plant process, quantity involved, and collector design. Dry collectors are unloaded continuously or in batches through dump gates, trickle valves, and rotary locks to conveyors or containers. Dry materials can create a secondary dust problem where careful thought is not given to dust-free material disposal or to collector dust bin locations suited to convenient material removal. Wet collectors are arranged for batch removal or continual ejection of dewatered material by flight conveyors or draining as a slurry. Secondary dust problems are eliminated, although disposal of wet sludge can be a material handling problem. Solids carry-over in waste water can create a sewer or stream pollution problem if waste water is not properly clarified.

Material characteristics can influence disposal problems. Packing and bridging of dry materials in dust hoppers, floating or slurry forming characteristics in wet collectors are examples of problems that can be met.

Types and Applications

Dust collectors are currently manufactured by 50 or more companies in the United States alone. Designs are varied, often employing more than one of the known principles of separation of a solid, fume, mist or vapor from a gas stream. Each year a number of new designs are introduced, many of which find their application range after a shakedown period between the fond hopes of the inventor and the realities of the maze of factors that influence successful performance for the different problems encountered.

Most collectors can be grouped into one of the three following classes, namely: (1) high efficiency, high cost; (2) high efficiency, moderate cost; and (3) lower cost and lower efficiency designs. Space prevents illustrating every variation in any one group. An effort has been made to select illustrations from designs that have demonstrated their effectiveness by extensive application over a period of years.

High Efficiency, High Cost Collectors

Electrostatic Precipitators. The high voltage electrostatic precipitator, Fig. 2, is the predominant collector in this group. It should not be confused with the low voltage, small dust holding designs used in air filtration.

The principle of collection relies on the ability to import a negative charge to the particles in the gas stream causing them to move and adhere to the grounded or positively charged collector plates. Most precipitators are made for horizontal air flow with velocities of 100 to 600 fpm. The collecting plates or electrodes are parallel elements usually on 9-inch spaces and constructed in various ways including corrugated or perforated plates or rod curtains. The electrode rods are centered between the collector plates. Voltage difference between electrode and plate is 60,000 to 75,000 volts in most designs. Collector plates of cylindrical shapes surrounding the electrode rod are provided where water is used to wash off collected material and where the gas stream is under high pressure or vacuum.

Removal of the collected material is obtained by rapping or vibrating the elements either continuously or at predetermined intervals. Vibration or unloading usually takes place without stopping air flow through the precipitator, although some loss in the cleaned air can be expected in most applications during the cleaning cycle.

Pressure drop is negligible, collection efficiency is high and nearly uniform regardless of particle size including sub micron particles, space is relatively large, and cost is extremely high where small gas volumes are involved due to the cost of high voltage electrical equipment. Efficiency is improved with increased humidity of the air stream as a change takes place in the dielectric properties of the dust. Heavy concentrations, on the other hand, cause a reduction in collection as the space charge on numerous particles blankets the corona effect from the electrode.

Electric precipitators have been extensively used in high temperature gas cleaning from equipment such as blast furnaces, open hearth furnaces, central station pulverized fuel boilers. The chemical industry has many applications including sulfuric acid plants, carbon black, cement kilns, soda ash from paper mill black liquor furnaces. As voltage setting is close to the spark over potential, application is limited to materials that are not explosive or combustible in nature unless the carrier gas stream is an inert gas.

Sonic Devices. In this same group can be placed recent efforts to use sound waves to agglomerate small particles into particle clumps of 5 to 15 microns so lower cost collection equipment can be used to remove the materials. The power required to impart the necessary force to maintain required intensities in an air stream has retarded extensive use of this principal in present day air cleaning devices.

High Efficiency, Moderate Cost Collectors

This group of collectors will include the fabric collector group and many wet type designs.

Fabric Collectors. The effectiveness of passing air or gas through a fabric at low velocity has been recognized and used for many years in air cleaning devices. Fabric is arranged in envelope or tubular (stocking) shapes as illustrated in Fig. 3. While removal appears to take place by a straining action of the media, actually collection is obtained in arresters in this group by building up a mat of the material on the dirty air side of the media that provides the filtering or straining bed. By means of this bed, a high degree of removal is obtained even on sub micron size particles. Where new fabric is placed in service, visible escapement will often occur during initial operation until the buildup of the dust mat occurs. Most usual fabric is a special woven cotton, although wool, paper, glass cloth, and synthetic fabrics will be used on certain applications.

Considerable data has been presented to show variation in rate of resistance rise during the initial cycle of loading a clean fabric. Such investigations are largely academic as the pressure drop of different fabrics for the same application and rating will be comparable after the dust mat has been formed.

As dust is collected on the fabric, resistance to air flow increases. Periodically (usually on 4 or 8-hour intervals) air flow must be stopped and the arrester reconditioned by rapping, shaking, or vibrating to agitate the fabric sufficiently to drop the bulk of the adhering material to the dust hopper. Pressure drop after vibration will be considerably higher than the loss through new clean fabric. Sufficient dust adheres to the fabric to maintain the dust mat needed for maximum efficiency. Unless the air flow is stopped, released material is re-entrained and considerable escapement also occurs through the sealing devices used to hold the fabric to its supports.

Rate of flow through the media seldom exceeds 4 fpm and often is as low as 1 fpm. Ratings are usually selected so pressure drop will be in the 2-inch to 5-inch range

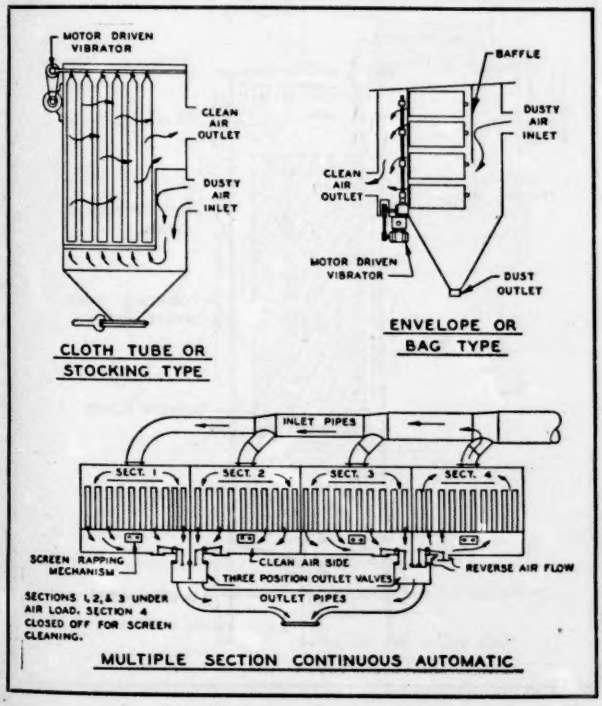


Fig. 3. Fabric type arresters.

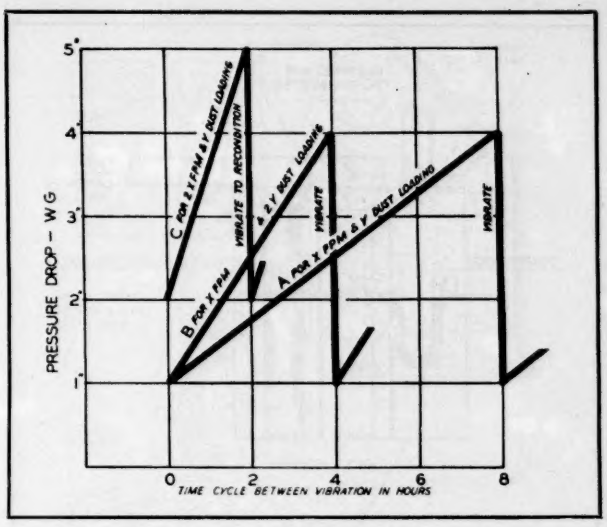


Fig. 4. Pressure drop through fabric arresters.

between start and end of a cycle. The smaller the particle, the more rapid the resistance rise for a given loading. For a given air flow rate and dust loading, resistance rise increases directly in proportion to time. Air flow is in the sinuous range where resistance through the fabric at any stage of loading will vary directly with change in air flow. Influence of higher air flow rates or longer intervals between vibration can be calculated from these relationships.

Fig. 4 illustrates these relationships. Line *A* indicates that for one application the pressure drop across the arrester would drop to 1-inch after vibration and increase as the first power to 2.5-inch at the end of 4 hours operation; 4 inches if the vibration cycle was delayed until 8 hours of operation. By keeping the same air flow rate but doubling the dust loading (dust to be same material and to have some median particle size), resistance after vibration would still be 1-inch, although resistance would increase to 4 inches at the end of 4 hours operation. Line *C* illustrates the problem of trying to increase air flow rate. Doubling the air flow rate through the fabric will double the resistance after vibration. With the same dust loading per cubic foot as that in condition *A*, resistance rise will increase as the square or four times as fast as in condition *A*. The second power relationship is the combination of increased dust loading rate (twice as many pounds of dust must be collected on a square foot of fabric when the air flow rate through the cloth is doubled).

Fabric collectors are extensively used in industry for a wide range of applications. They require more space than most other types of air cleaning devices which necessitate outdoor installation in most cases. Erection cost is high due to prevailing practice of completely knocked down construction when shipped by the manufacturer. Variation in air flow due to changing pressure losses is sometimes a disadvantage and the problem of dry dust removal often introduces a secondary dust condition.

Fabric collectors are limited to air conditions dry enough to prevent condensation or free moisture deposition on the fabric. With some materials, there will be a bonding tendency between particles and fabric under high relative humidity even though no condensation takes place. Maximum recommended temperature is for

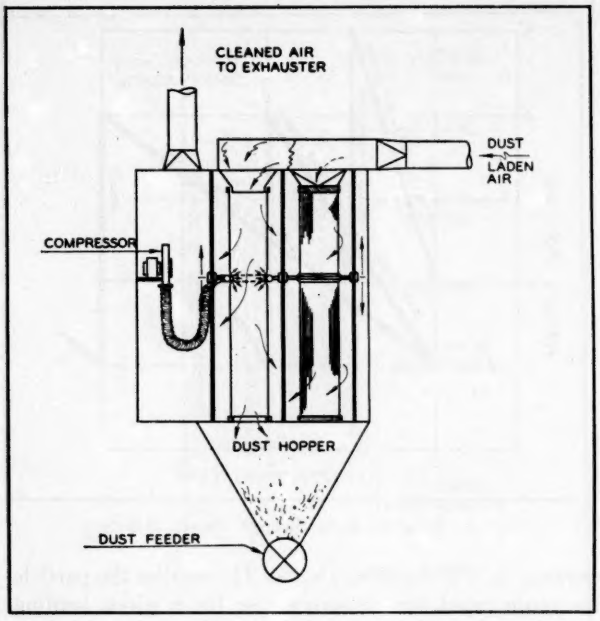


Fig. 5. Reverse jet type of continuous fabric arrester.

cotton fabric 180F, for wool 200F. Higher temperature can be handled, but equipment cost is considerably increased by using synthetic materials including nylon and orlon fabrics as well as glass cloth and occasionally fine metallic mesh.

Continuous Duty Fabric Collectors. The disadvantages of stopping the air flow to permit vibration, and the variation in air flow can be overcome in several ways. Use of sectional arresters, as indicated in Fig. 3, allows continuous operation of the exhaust system as automatic dampers periodically take one section out of service for vibrating the fabric while the remaining sections handle the entire gas volume. The larger the number of sections, the nearer the pressure loss will remain constant. The use of reverse air flow to increase effectiveness of removing adhering material is usually incorporated in such designs. Damper mechanisms are interlocked so inlets to the outside are opened to allow a small amount of air to flow in reverse direction through the fabric. Mechanism does add equipment requiring additional attention and servicing due to the difficulty of good damper sealing in a dust-laden air stream.

Reverse Jet Type of Continuous Arrester. This type arrester was developed in the United States several years ago and is currently produced by several manufacturers. It differs from the conventional arrester in its use of high pressure air jets from a moving "blow ring," dislodging the material from the inside of the stocking shape of the fabric. Cleaning or reconditioning by this method is more complete than that obtained by conventional vibration, making it necessary to use a thicker felted media to make up for the more complete removal of the dust mat. See Fig. 5.

Higher air flow rates are possible with the continuous or short reconditioning cycle of collectors in the continuous group. Filter rates up to 15 fpm are usual and for lighter duty applications, rates of 20 fpm and higher have been reported. Fabric collectors in this category are more expensive and introduce the added maintenance and servicing of mechanisms needed to provide the continuous duty designs. Pressure loss will be more nearly uniform generally in the 4-inch to 6-inch range if properly rated.

Wet Collectors. Intensive development work on wet collector designs started in the late 1930's. Collector designs now available emphasize the widespread field of application in high efficiency dust control problems that collectors in this group are suited. Wet type collectors are difficult to catalog as they employ a multiplicity of methods to wet the contaminant and remove it from the air stream. A wide range also occurs in their cost, pressure drop, and collection efficiency.

Wet collectors offer the advantages of constant exhaust volume, no secondary dust problem during disposal (a decided advantage where particles are under 10 microns), and an ability to clean high temperature and/or moisture laden gases. They are reasonably small in space requirements. Collection efficiency varies with the design, although most designs have a dropping off efficiency curve somewhere between 1 and 10 microns. Generally, the lower the pressure drop and the lower the initial cost, the lower the efficiency in the minus 10 micron particle sizes.

Use of water introduces disadvantages. Costly corrosion resistant construction can be required for applications involving corrosive gases or materials; water clarification necessary before disposal or reuse may be difficult or expensive.

Wet collectors have many applications such as cleaning air from kilns, roasters, coolers, dryers, handling fine dust, fumes, vapors, and mists released from operations in food processing, chemical industries, foundries and metal working, ceramics, rock products and metal mining.

Packed Towers. The history of packed towers, Fig. 6,

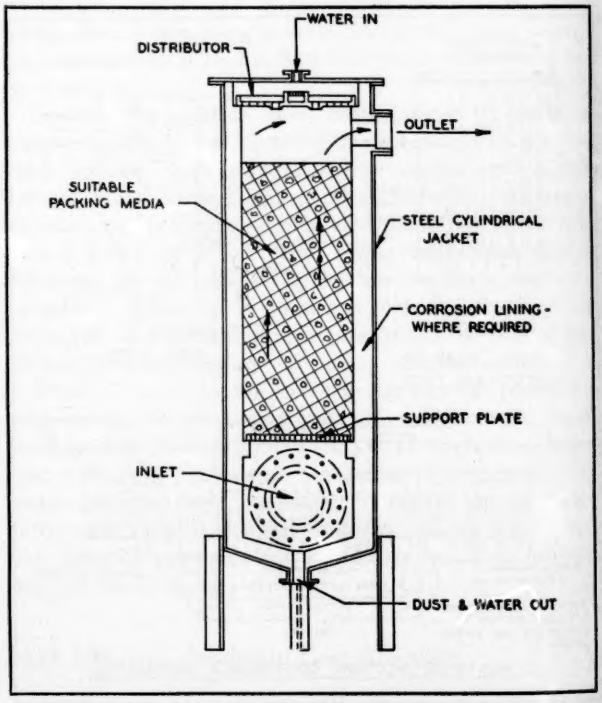


Fig. 6. Packed tower.

dates back many years, although use of such towers has been largely restricted to the chemical industry where they are still extensively used as gas scrubbers to remove gases and vapors. Removal of the contaminant relies on long contact time between the entering gas stream and the wetted surfaces of the packing. Water flow is usually downward with water rates of 5 to 10 gals per 1,000 cfm of standard air. Packing material is usually irregular shaped ceramic saddles, although coke, gravel, and similar products have been used. Pressure drop will range from 1½ to 3½ inches for the usual 4 ft thick bed with face velocities in the 100 to 300 fpm range. Packed towers require considerable space due to the low velocities through the packing. Plugging of the packing can occur with heavy dust loadings and removal of packing for cleaning or replacement is not practical at frequent intervals. The simplicity of the design recommends its use for systems under high pressure or high vacuum and for construction to withstand highly corrosive conditions.

Wet Centrifugals. Two types of wet centrifugal collectors are shown in Fig. 7. Typical of this group, collection relies on throwing the heavier particles against wetted collector surfaces by centrifugal force. Water rates are usually in the 3 to 5 gal per 1,000 cfm of gas cleaned. Water distribution can be from nozzles, gravity flow or induced water pickup by the air stream. Pressure drop will vary from 2½ to 6 inches and often a design will be offered in models having different numbers of impingement elements, sacrificing some collection of fine particles for lower cost, lower pressure drop, and smaller equipment.

Wet Dynamic. The wet dynamic precipitator, Fig. 8, combines the dynamic and centrifugal forces of a rotating fan wheel to cause the contaminant to impinge on the numerous specially shaped blades on whose surfaces a film of water is maintained by spray nozzles at the inlet. No external pressure loss is involved in collectors of this type, although their mechanical or blower efficiency is lower than conventional exhausters. For heavier dust loading, a wet type centrifugal precleaner is often used in conjunction with the precipitator. Water requirements range from 0.5 to 1 gpm per 1,000 cfm of gas cleaned.

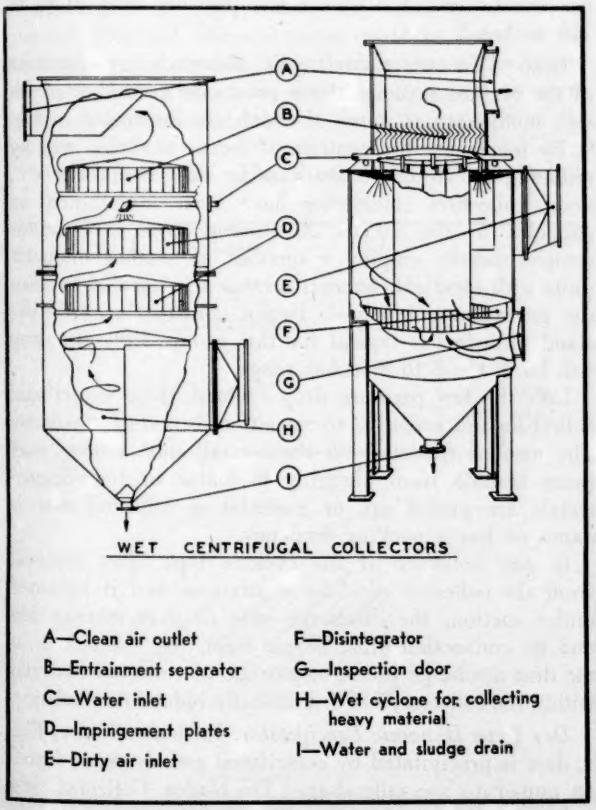


Fig. 7. Two types of wet centrifugal collectors.

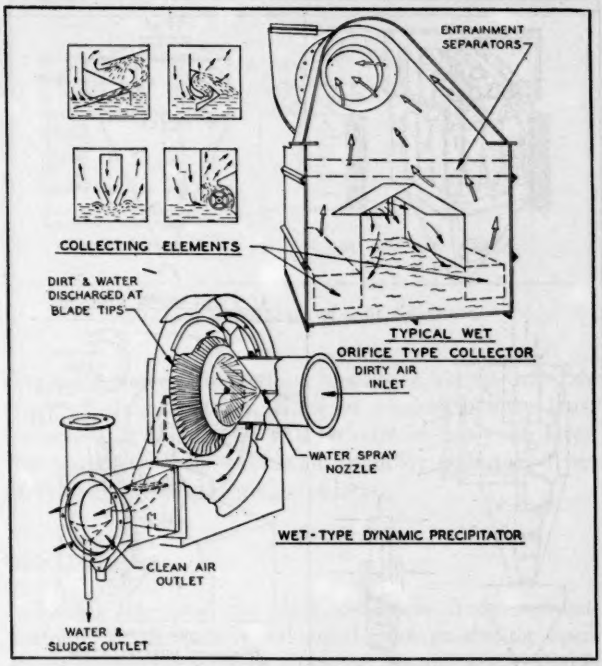


Fig. 8. Wet type dust collectors.

Orifice Types. During the early 1940's, a number of manufacturers introduced collectors in this group. Fig. 8 shows typical construction. Cleaning relies on the pickup or delivery of large water quantities to a collecting zone where centrifugal forces, impingement, or collision causes wetting of the contaminant before its removal from the air stream. Water quantities in motion are high, running from 10 to 40 gal per 1,000 cfm. Much or all of this water, however, can be recirculated without the use of distribution spray nozzles or recirculation pumps.

Design simplicity has considerable appeal and the absence of ledges, moving parts, or restricted passages makes such units especially adapted to materials like magnesium or explosive dusts, and for sticky or linty materials like metallic buffing exhaust. Many of the water wall spray booths incorporate elements of such collection principles, especially those designs where the pressure loss is in the 3 to 6-inch range.

Pressure drop of orifice type collectors varies with the design, ranging from 2½ to 6 inches or more. Variation also occurs in the methods used for entrainment removal before the cleaned air leaves the collector. Similar differences will be found in methods of supply water introduction, methods of water level control, and protection against solids carry-over during overflow in drain.

Highest Efficiency Wet Collectors. The national emphasis on air pollution control and the need for moderate

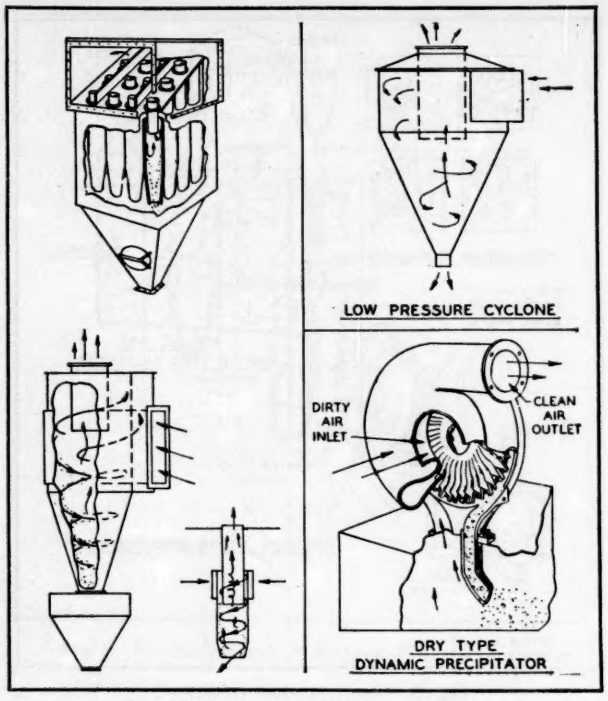


Fig. 9. Dry type centrifugal collectors.

cost collection equipment for sub micron particles from high temperature gases have resulted in the introduction of wet collectors with improved efficiency on particles under 1 micron. Major efforts have centered around means of breaking water droplets into finer particles to increase the probability from impaction and dispersion of contact between small contaminant particles and the water droplets or mist. The probability of this is highest where dust and water particles are the same size and where concentration of particles is high.

Two methods in commercial designs use either high pressure nozzles or high velocity venturies to break down the water droplets to small size. High pressure nozzles are normally installed in tower types of centrifugal collectors. A large number of small nozzles is involved, using water pressures of 250 to 600 psi and water volumes of 5 to 10 gallons per 1,000 cfm. Distribution of the droplets must be such that dispersion increases the chances of impact between water droplet and contaminant particle, rather than droplet against droplet to reform larger size, less effective droplets. The use of small nozzle orifices makes recirculation of water impractical for most industrial operations.

In the venturi design, the shear stresses of the air stream traveling at velocities of 12,000 to 20,000 fpm are used to break up water introduced through open supply pipes in the venturi throat. The turbulence in the venturi is utilized to disperse and cause impact with contaminant within a short time interval. Space required for this design is small, recirculation of water is possible, but pressure loss is extremely high, usually in the 12 to 16 inches range.

In spite of the higher efficiency obtained by this group of wet collectors, their applications to date have been considerably restricted. In spite of reducing the weight of escaping materials by 50% or more when compared with other wet collector designs, discharge will still be visible for many of the metallic fumes. Problems still remain where air pollution authorities have asked for practically invisible discharge appearance from such stack effluents.

Low Cost, Lower Efficiency Designs

With the tendency to focus discussion on the present day need for high collection efficiency, the importance of the dry types of primary collectors is often overlooked. Collectors in this group will always find extensive industrial applications for coarser dusts in light to moderate loads such as are present in the exhaust ducts from the following processes or industries: Woodworking, metallic grinding, polishing and buffing, grain dust and chaff from elevators, flour and feed mills, product collectors in pneumatic conveying systems, fly ash collection from spreader stoker and pulverized fuel boilers, primary collectors from dryers, coolers, and kilns either in conjunction with final high efficiency collectors or as the only collector.

Low Pressure Drop Cyclone. One of the earliest collector designs in this group is the well known and still extensively used cyclone, Fig. 9, which depends on centrifugal force to spin the heavier particle against the conical section of the collector and to force it out the dust outlet at the apex. Collection efficiency is sensitive to variation in exhaust volume, and the centrifugal forces available from angular acceleration reduce as the design is developed for larger air volumes. Collection efficiency usually drops off as particle size reaches the 20 to 40 micron range except where very heavy concentrations are handled in closed pulverizing circuits and other low pressure pneumatic conveying applications. Cyclones are low in first cost and have a low pressure drop of ¾ to 1½ inches.

High Efficiency Centrifugals. Research investigations of the cyclone principal have produced a number of design modifications, some of which are illustrated in Fig. 9. By increasing the centrifugal forces available and by reducing the design faults causing dust re-entrainment, good collection efficiencies have been maintained on particles in the 10 to 20 micron groups. Collector designs usually employ a number of smaller diameter units with identical elements arranged in parallel to clean the gas volume involved. Heavy construction to withstand abrasion is typical for this group. Pressure drop will be in the 3 to 8 inches range.

Like the low pressure drop cyclone, these centrifugal collectors are sensitive to variation in exhaust volume. The smaller models with their small dust outlets may cause trouble from plugging if coarse or foreign materials are picked up, or material is collected that is damp or has a packing tendency.

In any collector of the cyclone type, dust removal from the collector must be continuous and if operated under suction, the discharge gate or dust storage bin and its connection must be air tight. Air leakage in at the dust discharge point, or storage of collected material within the collector, will dramatically reduce its efficiency.

Dry Type Dynamic Precipitator. In this collector, Fig. 9, dust is precipitated by centrifugal and dynamic forces on numerous specially shaped fan blades. Collected dust is forced along the blade surfaces and is discharged into

a separate dust circuit within the fan housing. From here, it is conveyed pneumatically to a dust storage hopper. Collection efficiency is in the range of the high efficiency centrifugals, and space requirements are extremely small. Design does not lend itself to large exhaust volumes or to the handling of fibrous, sticky materials or to applications involving the collection of large pieces of product or foreign material.

No external pressure loss is involved, although the mechanical efficiency of the precipitator will be lower than that of the conventional industrial exhauster which it replaces.

Louver Type. Centrifugal forces can be applied to a particle by a rapid change in direction of air flow by a series of plates set at an angle to the air stream as illustrated in Fig. 10 and as demonstrated by Knickerbocker prior to his invention of the cyclone in 1888. Coarser particles traverse the air stream and are kicked back into the dirty air side by the rebound vector and the aerodynamic spin that can be produced from such an impact.

Efficiency will be essentially a function of louver spacing. The closer the spacing, the higher the efficiency but also the greater the probability of plugging of the air passages—plugging due to both buildup on the front and back of the louvers, and mechanical obstruction by larger particles. For a louver spacing, practical for industrial air cleaning applications, efficiency will drop off the same as in other dry type centrifugal devices. The smaller the particles, the greater the difficulty of transversing through the air stream to the deflector plate due to the air viscosity.

Prime advantages of the louver type of primary collector is its simplicity and low cost of its construction plus its relatively low pressure drop for the degree of removal obtained. Disadvantages could be listed as the tendency for accumulations and abrasion on the louver elements. A secondary air circuit is required to carry away the dust concentrated on the dirty air side of the louvers.

Inertial Collectors. The discussion will not include

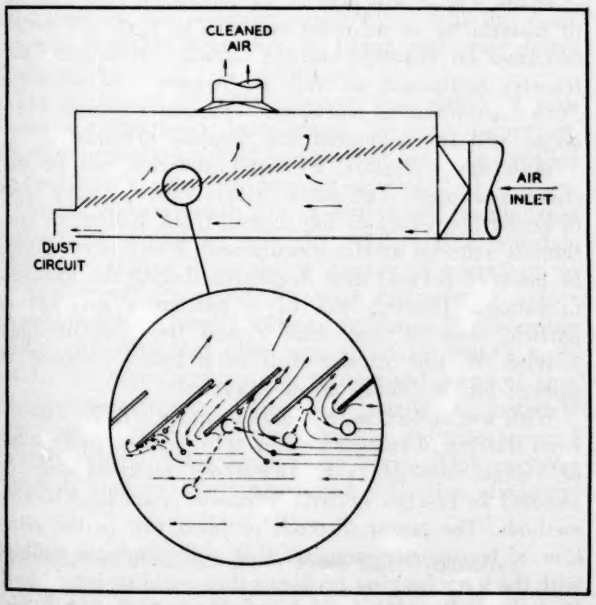


Fig. 10. Louver type collector.

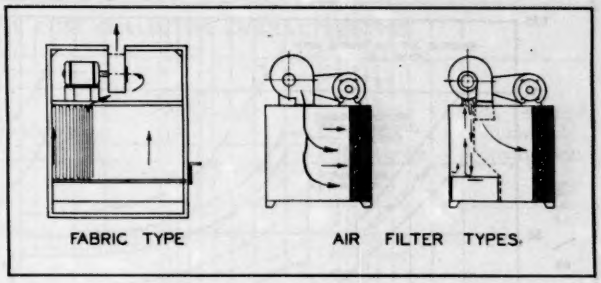


Fig. 11. Two groups of unit collectors.

detailed comments on settling chambers, simple deflector types of cinder catches, traps or cinder-catching fans. Collectors in this group will be effective only on large size particles or for protection of other collectors from carry-over of large foreign objects.

Unit Collectors

To fill the need for dust collection from isolated, portable, or frequently relocated dust producing operations, a number of unit collector designs are available having capacities in the range of 200 to 1,000 cfm. Featuring small space and designed to recirculate the air, collectors of this type have been used extensively, especially in the metal working industry.

Most of the criticism leveled at this group has been prompted by their misapplication where purchasers have failed to appreciate their limitations. Intended for lighter dust loads and/or intermittent operations, the dust holding and storage capacity, servicing facilities, and longer periods between maintenance, have all been sacrificed, in many cases, for small space and low first cost. While performance can be completely satisfactory for lighter loads such as tool room grinders, occasionally use cut-off saws, or light loadings for package filling, applications should be carefully examined before installation is recommended for continuous dust producing operations which release moderate or heavy quantities of fine dust.

Their use also becomes questionable where a larger number of unit collectors are installed within an area in which a central exhaust system would be practical. The dust removal and servicing requirements from a number of such unit collectors are expensive and are more apt to be slighted than would be the case with a single large collector with its one dust disposal point, its greater dust storage capacity, and a construction that could reduce frequency of service and maintenance attention required.

Unit collectors, Fig. 11, normally fall into two groups. Fabric collectors use cloth envelopes quite closely spaced, with some manual means of vibration, and with air velocities through the fabric of 8 to 12 fpm. The fan filter group uses an air filter, usually of the viscous impingement type, preceded by some primary collector which may be a simple settling chamber or a more effective centrifugal collector.

Dust Collection Equipment Cost

The variation in equipment cost, especially on an installed basis is difficult to estimate and any figures to

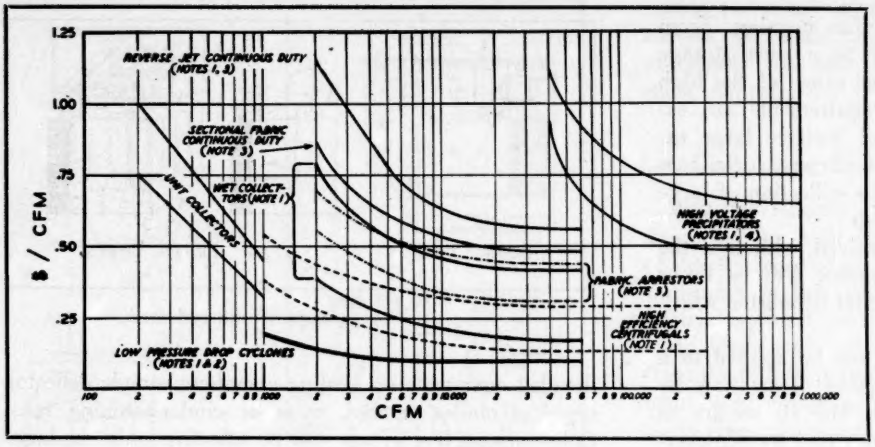


Fig. 12. Cost estimate of dust collecting equipment as shipped by the manufacturer.

Note 1: Where collectors are normally furnished without exhausters, $.07/cfm has been added for exhausters.

Note 2: Where collectors are normally furnished without dust storage hoppers, $.03/cfm has been added for dust storage hoppers.

Note 3: Price of collectors in the group could be more accurately estimated on the basis of number of square feet of media for fabric arrestors, as there are wide variations for a given exhaust volume, dependent on the application. Estimates assume flow rates of 3 fpm through fabric arresters and 15 fpm through reverse jet designs.

Note 4: Price of electrostatic precipitators will vary with the contact time and the electrical equipment required. Prices shown are for fly ash installations when high velocities of 300 to 600 fpm are usual. Precipitators for metallurgical fumes, etc., will be considerably higher in cost per cfm.

use for comparisons are complicated unless a thorough knowledge of the factors included or the items not included are carefully evaluated. Factors which make useful cost estimates difficult to furnish include:

Price Versus Capacity. All dust collector prices per cfm of gas handled will vary with the volume involved. The smaller the volume, the higher the cost per cfm. The break point, where price per cfm cleaned tends to level off, will vary with the design, as can be noted from a few typical curves shown on Fig. 12.

Accessories Included. Careful analysis of components of equipment included is very important. Some collector designs include exhaust fan, motor, drive, and starter. In other designs, these items and their supporting structure must be secured from other sources by the purchaser. Likewise, while dust storage hoppers are integral parts of some dust collector designs, they are not provided in other types. Duct connections between elements may be included or omitted. Recirculating water pumps and/or settling tanks may be required and may not be included in the equipment price.

Installation Cost. Installation cost can equal or exceed the cost of the collector, depending on method of shipment (completely assembled, sub-assemblies, or completely knocked down), on location which may require expensive rigging to put in place, and on expensive supporting steel and access platforms. The cost picture can be measurably influenced by the need for water and drain supply, special or extensive electrical work, and expensive material handling equipment for collection material disposal. Items in the latter group will often also be a variable decreasing in cost per cfm as the volume of gas to be cleaned increases.

Special Construction. Prices shown in any tabulation must necessarily assume standard or basic construction. Increase in cost for corrosion resisting materials, special high temperature fabrics, insulation and/or weather protection for outdoor installations, can introduce a multiplier one to four times standard construction cost.

With all the reservations mentioned, some idea of dust collector costs is provided in Fig. 12. The additional notes and explanations included in this data should also be carefully examined before data is used for estimating cost of specific installation. In the final analysis, it will be safer for the customer to call in the equipment manufacturer or installer and to get estimates for his specific problem unless a past history record for similar control problems is available. Table 1 lists other characteristics that must be evaluated along with equipment cost.

Price estimates included in Fig. 12 are for equipment of standard construction in more usual arrangement. Estimates for exhausters and dust storage hoppers have been included as indicated in Notes 1 and 2 where they are normally furnished by others. Prices can be multiplied by factors of 1 to 4 where special metals and/or special fabrics are indicated to resist corrosion and/or high temperatures. Installed costs are subject to even wider variations due to assembly work required on location, rigging costs based on actual location selected for equipment, supporting structures and foundations, variation in electrical, plumbing, connecting duct work that may be involved. Installed dust collecting cost estimates can range from 1.20% to 200% or more of the cost of collector as shipped by the manufacturer.

Provisions for Dust Disposal or Salvage

Many a headache would be prevented if material handling of collected material were considered at the time collector design and location are examined. Quantity of material will influence disposal equipment and methods. Fig. 1 will provide an estimate of the quantity of material to be collected and this in turn will permit estimates on required storage capacity of hoppers and transfer equipment as well as frequency of servicing. Such considerations will assure collector locations where access will be convenient and disposal practical.

With dry collectors, collected material can be discharged through dust gates, trickle valves, rotary locks or screw conveyors to tote boxes, truck bodies, or continuous material handling equipment. Every effort should be made to prevent dust dispersion during the handling operations. Dusting will be a particular problem as particle sizes become smaller and the concentrations heavier. Wetting of dry dust as it leaves collector or storage bin is difficult to do effectively.

With wet collection, disposal methods will be selected from sluicing of collected material to process, waste tract, or remote settling tank. Dewatered material may be handled in batches or by continuous material handling methods. The major disposal problem will be the selection of transport equipment that will eliminate spillage with the housekeeping problems that could be introduced. Water supply and waste water disposal should be in-

TABLE 1—COMPARISON OF SOME IMPORTANT DUST COLLECTOR CHARACTERISTICS

Type	Higher Efficiency Range on Particles Greater than Mean Size in Microns	Pressure Loss, Inches	H_2O Gal per 1,000 CFM	Space	Sensitivity to CFM Change		Humid Air Influence	Max. Temp., F, Standard Construction
					Pressure	Efficiency		
Electro-Static	0.25	½	-	Large	Negligible	Yes	Improves Efficiency	500
Fabric:								
Conventional	0.4	3-6	-	Large	As cfm	Negligible	May make recondi-tioning difficult	180
Reverse Jet	0.25	3-8	-	Moderate	As cfm	Negligible		200
Wet:								
Packed Tower	1-5	1½-3½	5-10	Large	As cfm	Yes	None	Unlimited
Wet Centrifugal	1-5	2½-6	3-5	Moderate	As $(cfm)^2$	Yes		
Wet Dynamic	1-2	Note 1	½ to 1	Small	Note 1	No		
Orifice Types	1-5	2½-6	10-40	Small	As cfm or less	Varies with design		
Higher Efficiency:								
Nozzle	0.5-5	2-4	5-10	Moderate	As $(cfm)^2$	Slightly to Moderately	None	Note 2
Venturi	0.5-2	12-20	-	Small				Unlimited
Dry Centrifugal:								
Low Pressure Cycle	20-40	¾-1½	-	Large	As $(cfm)^2$	Yes	May cause condensa-tion & plugging	750
High Eff. Centrif.	10-30	3-6	-	Moderate	As $(cfm)^2$	Yes		750
Dry Dynamic	10-20	Note 1	-	Small	Note 1	No		750
Louver	15-60	1-3	-	Small	As $(cfm)^2$	Moderately		750

NOTE 1: A function of the mechanical efficiency of these combined exhausters and dust collectors.
NOTE 2: Precooling of high temperature gases will be necessary to prevent rapid evaporation of fine droplets.

vestigated also before final decision on collector arrangement and location.

Equipment Location, Servicing and Maintenance

Because dust collection equipment is not truly production machinery, it has too often been installed in a place that is inaccessible with the unfounded hopes that once installed it can be forgotten. Nothing is further from the truth and the more effective the design, the more complicated will be the collector construction and the more frequent need for inspection, servicing and preventative maintenance.

The provision of access ladders and servicing platforms for overhead installations is very important. Weather protection should be provided for units installed on roof tops or in other outdoor locations.

Manufacturer's installation, operation and maintenance instructions should be carefully read, and a schedule established setting down the frequency of operations to be performed. Provision for part replacement before actual breakdown occurs will pay dividends in preventing costly shutdowns that often stop an entire plant's operation. The manufacturer can recommend ways of spot checking performance. Often it is possible to install U gages or ammeters that will quickly indicate reduced exhaust volume. Most designs also have tell-tale sections that will indicate less contaminant collection efficiency.

Recirculation of Cleaned Air From Dust Collectors

With the expanding use of local exhaust ventilation, the volumes of air handled in most industrial plants have increased each year. Discharge of air to the outside introduces a number of problems such as:

(1) Substantial heat loss, not only increasing the cost of plant heating, but often straining heating plant capacity.
(2) Severe economic loss in plants where cooling and/or humidity control is supplied.
(3) Added expense for plants that must frequently change production layouts which mean the relocation of dust producing machines with extensive alterations to exhaust ducts discharging through roof or outside wall.

While it is the goal of dust collector manufacturers to develop equipment that will permit safe recirculation of all industrial contaminants, that point in design and fool proof operation has not been reached particularly where toxic materials are collected. Most authorities are reluctant to recommend recirculation from collectors handling toxic dusts, fumes, mists or vapors as there is no assurance that required high degree of efficiency will be maintained and no recording instruments have been developed to indicate when safe degree of cleanliness of effluent has been exceeded.

Recirculation from non-toxic materials does not introduce such hazards. Recirculation from processes as metal working, woodworking, food products, and pharmaceuticals plus grain dust and oil fumes has been used extensively in industry. Dust collectors designed for recirculation will normally be of the more expensive designs often requiring more service attention. These factors should be weighed against the advantages of

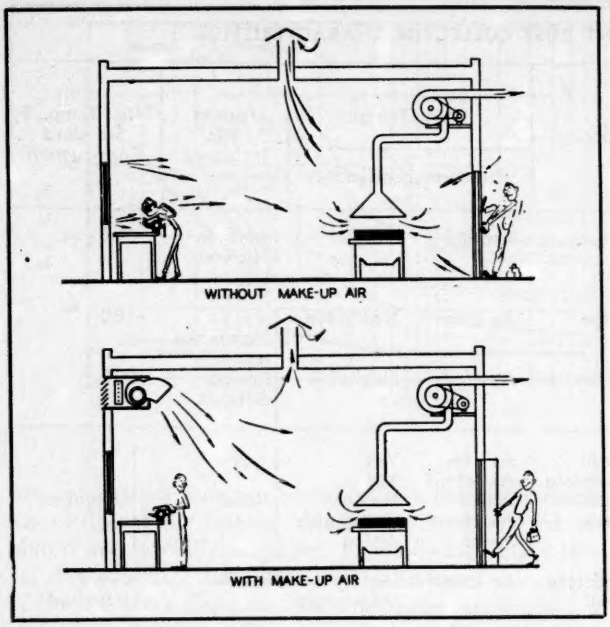


Fig. 13. Influence of make-up air on working conditions.

recirculation before a decision is made to return the cleaned air.

Make-up Air Supply

While every plant engineer will admit that you can not discharge air from exhaust systems to the outside without replacement air entering the plant, hundreds of exhaust systems operate with reduced effectiveness during the winter months because of an air-locked plant. Doors that almost refuse to be opened because of the negative pressure in the workroom, cold drafts from outside air which is sucked through cracks around windows and doors, reverse air flow into the plant from roof combustion gas stacks, ventilators and propeller exhaust fans—all are indicators pointed out in Fig. 13 that the workroom urgently needs a makeup air supply system.

Don'ts

A check list of things not to do in the selection and application of dust collecting devices should be useful. Reviewing items such as the following would save many a sour or ineffective dust collecting system.

(1) Don't hope to provide a dust collector by tying a burlap bag over a discharge pipe, or directing the discharge duct into a barrel of water or into a settling chamber. Factors involved in the collection of small particles do not lend themselves to such elementary treatment. Hundreds of times each year, hopes are blasted in such attempts at the cost of dollars, man-hours and loss of face.

(2) Don't put two collectors of the same order of efficiency in series. The second collector will not remove enough material to alter discharge appearance, public nuisance complaints or settlement in plant area unless initial unit is not functioning satisfactorily. Exceptions could include installations where agglomeration of particles are involved, or where a second collector is used to remove material concentrated in a carrier air stream from the first collector.

(3) Don't visualize discharge appearance based on efficiency data. Fine particles have many, many more light reflecting surfaces per pound than coarse particles. Appearance of effluent air will be governed by efficiency of collector, particle size of the contaminant, and *concentrations* of the solid particles. Often the removal of 85% of the solids from a local exhaust system will make no visual change in the discharge stack appearance.

(4) Don't expect dust collection equipment design to be more advanced than productive machine design. Generally, the higher the degree of effectiveness,, the more certain the need of periodic servicing, inspection, and part replacement. Such operations will not receive proper attention where (1) collectors are placed in inaccessible locations without ladders, working platforms, and lighting and (2) in outdoor locations where workmen are exposed to rain or winter weather.

(5) Don't wait for dust collectors to fail before ordering replacement parts. Periodic inspections will give ample warning. Under present day working conditions, failure of a dust collector can mean the halting of production lines, while long distance calls and air express shipments attempt to reduce the downtime.

(6) Don't expect collectors employing principals used for lower efficiency primary collection to be developed that will give efficiencies equal to those of more expensive high efficiency units—hopes of the purchaser and enthusiam of the inventor not withstanding. The cost to American industry each year is a tremendous figure based on the hopes of purchaser and the enthusiasm and lack of understanding of the problem of dust control on the part of the inventor of such devices.

The history of new designs of collectors using, for example, centrifugal forces in a dry unit are one of many expensive misapplications based on the hopes of the inventor that his brain child will cure all industrial problems, and the expectation of the purchaser that by some twist of a piece of metal that fine dust particles will forsake the laws of aerodynamic behavior. There have been many worth-while design introductions in dust equipment design that have contributed to the effectiveness of available units, but the number is indeed small that have found their sphere of effectiveness by starting with modest claims instead of with the hopes of covering the entire field of industrial air cleaning devices. It should be apparent that no one method or design will be suited for all industrial problems, if the variation of concentration, particle size, and percentage of removal necessary are correctly evaluated.

(7) Don't expect replacement of the exhaust air volume to slip in through cracks in windows and doors without creating cold drafts in winter months, and often starving exhaust systems so that effectiveness is reduced. Makeup air supply systems can improve control, eliminate drafts, and warm the incoming outside air efficiently.

(8) Don't attempt to recirculate cleaned air from dust collectors handling toxic material without careful investigation of the policing required to be assured of maintained effectiveness.

(9) Don't install unit collectors on heavy duty production operations without careful evaluation of the frequency of servicing that could be required.

Theory vs. Practice in Radiant Heating

T. NAPIER ADLAM

Vice President, Sarco Manufacturing Co., and Technical Director, Sarcotherm Controls, Inc.

Part 5 of a six-part article. A discussion is presented of reduction in heat requirements, influence of windows on comfort and heating, and intelligent use of U-values.

IN the early days of radiant heating, I spent a number of years making exhaustive tests in several large size rooms using many types of floor construction, in an effort to ascertain how much heat could be obtained from various floor surfaces at predetermined temperature conditions. For these experiments, I erected, removed, and reconstructed different types of flooring many times, simply to discover the amount of heat which could be obtained from the floor surfaces and from the heating medium used in the pipe coils or air ducts. During these tests, I generally used hot water pipes embedded in the various construction materials then in use, although on occasional tests I used steam as the heating medium to obtain some comparisons of temperature. I also employed hot water and steam pipes supported in the air spaces of fabricated floors, as well as using warm air circulating in ducts formed in special types of floor construction

Many Tests Conducted

Because most of these original tests were carried out with floor surface temperatures ranging from 70 to 75F, I have, since residing in America, carried out many similar tests applying higher temperature water and steam to obtain higher surface temperatures. I also introduced electrical conductors as heating elements to provide temperatures which are more suitable for American conditions. I have made tests on large floor areas with the heated panels well insulated both below and on the sides of the panel to the extent that the percentage of heat loss downwards and sideways after long test runs was sufficiently low to be measured with very close accuracy or to be neglected without introducing any appreciable error in the value of total heat emission from the floor. I have also carried out many tests on large concrete slabs supported in different ways, including suspension in mid-air, so that I could measure the absolute total heat output from all surfaces in relation to the surrounding temperature conditions.

What perhaps is equally important in connection with this particular phase of investigation is the fact that in my early days of heating study, I carried out and recorded results from over a hundred tests on actual installations in residences, churches, cathedrals and schools, where cast iron radiators, warm air installations and convectors were employed, sometimes as individual systems and sometimes in combination as dual systems. In all these tests, I was well equipped with suitable instruments and assistance to measure very accurately the total amount of heat loss which took place in the various buildings. I used specially calibrated meters of different sizes and types to deal with both accelerated pump circulations and gravity systems to suit the respective jobs. Using these and other instruments to register comfort conditions, I was able to compile with inside and outside temperatures some very interesting data to compare with laboratory tests as to the values of U then in use. From these tests I was also able to compile some data which gave fairly accurate results as to the relative efficiency of various methods of heating and different mediums employed.

Possible Saving with Radiant Heat

I subsequently carried out similar tests with radiant heat installations to obtain the comparisons needed to determine if a greater efficiency is substantiated by using radiant heat panels. Personally, I have no doubt in my mind that the total heat loss from a building is less with a well designed and constructed radiant heat system than with many of the other heating systems. However, I have always hesitated to offer any definite suggestion as to what this reduction might be, because there appears to be so many inferior radiant heat systems installed where the loss of heat from the floor to the earth or from the ceiling to the roof often outweighs any saving which might be effected by virtue of the system. This brings us to a point where we have to face the third part of the same question put before me,—is it correct that no saving in fuel consumption is found in connection with radiant heat systems, especially those installed in America and Canada?

It may be of interest, therefore, to pursue this phase more closely, because it seems to be definitely related to our general discussion. In pursuing the question of savings, it may be of interest to say that while discussing various phases of radiant heating with an official of one of the large manufacturing firms in England during my previous visit to Europe, I raised the question of the reduction of heat loss estimated when using radiant panels as compared with radiators or other methods of heating. The reply I obtained was that for similar jobs, his firm invariably reduced the boiler power by approximately 40% when using radiant panels as compared with other types of heating units.

While there seems to be no apparent reason whatsoever for such a reliable manufacturing firm to reduce the

boiler power below a safe or economical limit, this reduction may appear to be somewhat drastic even for England, and yet I have no reason to doubt its validity. I mention this, however, because it seems quite obvious that since this firm, which has been manufacturing all kinds of heating equipment for many decades and panels for radiant heat systems for nearly 40 years, feels justified in making such a reduction, a considerable saving of heat appears to be thereby substantiated.

Reduction in Heat Requirements

Personally, I never hesitate to recommend a 10% or 12% reduction in the heat required if I know the system is to be installed by a reliable engineer, even without a check on the particular installation. In some other cases in which I have been personally interested, I have not hesitated to suggest a reduction of 15% or more if the conditions warrant it. One of the reasons I hesitate to suggest a larger reduction than that just given, without a careful examination of all the conditions, is that one has to remember that there are many factors arising from the design and method of construction which may easily cancel out any saving effected by using radiant panels and, furthermore, without a reasonable margin with embedded pipes in floors and ceilings, there is very little chance of boosting the heat for rapid pick-up.

Then again, I have found that the actual reduction in total heat losses when using a radiant heating system as compared with other types of heating, depends somewhat on the construction of the building. For instance, if two buildings are under consideration and both are of ordinary brick or stone construction, as is customary in England, with no provision made for insulating walls, ceilings or floors, or if we take even a frame house with little attention given to the insulation, and the windows and doors are left without weather stripping, as one sometimes finds in America, then the percentage saving in heat losses from the structure by using a radiant heating systems appears to be somewhat greater than would be the case if we compare two buildings in which the structures are well insulated with weather stripping and double glazing or storm windows fitted, as is usually the case with our better class residences. This, of course, is based on the assumption that the heated panels are well insulated at the back so that a large amount of heat is not conducted to the earth, outside walls, roof space, or in other ways, passed to the outside, the exact route depending on the location of the panels. While a difference in the total heat losses appears logical, it is very difficult to make a broad statement and recommend a definite percentage reduction to use, unless all the conditions of structure and locality are known.

Experience With Residence

Continuing with the question of saving it may be of interest to introduce some of my own personal experiences at home, because in my own residence, a large portion of the house is heated by conditioned warm air, while the other portion is heated with radiant panels in the floors and walls. Everything reasonably possible was done during construction to reduce the heat losses from the building, including 4-inch glass fiber insulation of roof, ceilings, and also the walls, and inner partitions. Weather stripping was added where necessary and storm windows fitted to all windows and outside doors.

There are two boilers supplying heat to the separate systems, each fitted with an oil burner, supplied from separate tanks. Therefore, by keeping records of prevailing conditions, it has been possible to obtain a fairly accurate estimate of the relative efficiency of these two systems, and also to obtain a close approximation of the actual heat losses from the building as compared with the calculated heat losses by using the usual values recommended for U.

During the eleven years I have occupied this residence, I have operated the system during two separate winters without the storm windows and storm doors to ascertain the effectiveness of these features, and while one of the winters selected for these tests happened to be a comparatively mild winter, the best estimate I can place on the value of the storm windows and doors is approximately a saving of 22% in fuel consumption. However, apart from the saving in fuel consumption, there is a very definite improvement in the comfort conditions when storm windows and doors are added, even though the rooms were kept at a slightly higher temperature during the two winters in question, to compensate for the cooler glass surface.

One of the big advantages of storm windows or double glazing, is the elimination of moisture and ice which forms on the inside of single glass windows during zero or sub-zero weather, when the air is conditioned or moisture added to the warm air. The increase in temperature of the rooms when the storm windows are eliminated amounted to one to three degrees, depending on the outside temperature and wind velocity, although for very low sub-zero weather the difference may have to be much greater. Also, from the results of my eleven years experience in this residence, my estimate would be that with all the heat saving features in use, the actual heat loss from the building is approximately 15% less than that calculated by using the usual values of U and other values obtained by the present methods recommended for calculating values for U where standardized values do not apply.

One difficulty in calculating the value of U for any combination of materials is that we are often left in doubt about the true value of the conductivity for one or several of the components, and also about the condition of the surfaces where two components are in contact. We are continually having new materials introduced into building construction, many of which are made or fabricated without any thought of heat economy, so that engineers are

Do You Want More Information?

What questions have you regarding radiant heating? Mr. T. Napier Adlam, the author of this series of articles, has offered to help you solve your problems if you will write him at Fountain Hill, Bethlehem, Pa.

often compelled to provide more heat than is really necessary to feel safe in their estimates for heat requirements.

Savings from Radiant Heat

As to the relation between the efficiency of radiant panels compared with the other system in my residence, my opinion is that if radiant panels were applied to the whole of the house, I would not expect a saving of more than 12%, probably less. It must be remembered, however, that I am comparing two very efficient systems, and so effective is the insulation throughout the entire house, that during several tests made in mid-winter with all the heat shut off for six hours, I found that the air temperature in the rooms did not drop more than two degrees. During ordinary operations in very cold weather, I rarely find the air temperature in any of the rooms varies more than one degree and it definitely is not possible by any variation in the feeling of comfort conditions to detect when the burner is in operation or not. If comparisons were being made between a radiant heat system with an ordinary warm air, steam radiator or convector system, or if these same two systems were installed in a building with greater heat losses, the results by comparison would undoubtedly be much more marked.

Pursuing this question of saving further, it seems to me that a very definite case of saving by using radiant heating has been proved by the results obtained from several gas stations installed and operated by one of America's large gas companies in the Philadelphia area. I understand, of eight gas stations erected on identical lines with practically the same exposure losses in all cases, four were fitted with radiant heated floor panels with the temperature of the circulating water modulated according to the outside air temperature, and four stations were fitted with unit heaters controlled by on-and-off controls. After four years' operation and very careful unbiased checks by the oil company's engineers, it was found that the oil consumption for the four radiant heating systems was only 65% of the oil consumed by the four stations fitted with unit heaters, with better heating results shown by the former.

It is not suggested that all well designed radiant heating systems will provide a saving of 40% or even 35%. However, it does seem logical to assume that some installations will show a considerable saving in heat loss and if such a heat saving as indicated by the action of the English firm recorded in previous article, and the four-year test results of what appears to be a very definite saving in Philadelphia be used as a basis, it would enable us to reduce an estimated output from floor panels based on heat losses, by a considerable amount. On this basis alone, an estimated emission of 70 Btu per hr per sq ft of surface from a floor panel, which has often been suggested, would be reduced to 45.5 Btu per hr per sq ft. However, the problem is not as simple as it might seem from such a transformation of figures, and it may be worthwhile to search deeper into this question with some hope of learning what we can about the differences of opinion concerning this somewhat controversial problem. While I have mentioned a claimed emission of 70 Btu per hr per sq ft, for the purpose of working out an example, I would like to say that quite often one finds very much higher claims and suggestions are made by interested

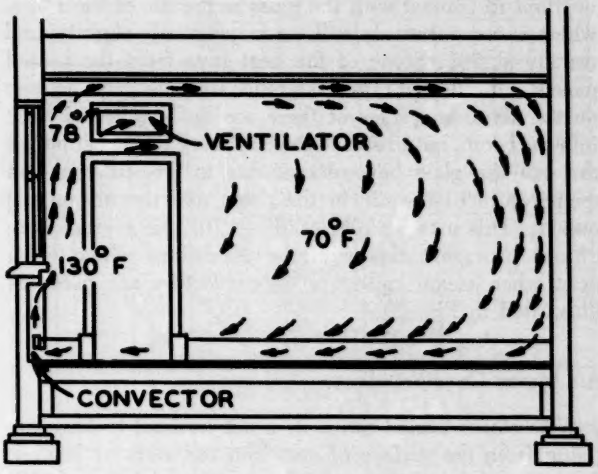


Fig. 20. Temperature distribution over window with steam heated concealed heater or hot air system.

advocates of floor heating, extending beyond ones imagination.

U-Value Is Too High

Reverting, therefore, to the question of why some advocates of radiant heating assume that it is possible to obtain very high emission factors for floor panels, it appears to me from the few cases I have examined, that in most cases their opinion is based on installations where a considerable amount of glass surface exists. This leads me to suggest that while, broadly speaking, the results they assume are due probably to all used values of *U*, in general, being too high, it seems to be especially due to the very high value given to *U* when dealing with glass windows or skylights. For many years, I have maintained that the value of *U* usually applied to glass is much too high, and while I have suggested in my book,—Radiant Heating, that for American conditions a value of 0.95 Btu is sufficiently high for *U* when making ordinary heat loss calculations for glass, I did so with the personal knowledge that in many instances the loss of heat will actually be less. In France I learned that many authorities for single glazing, use a factor of 0.90, while I have known some engineers who use a value of 0.5 only, for radiant heat installations.

Influence of Windows on Heat Loss

While it is common practice to use the gross area of all windows in heat loss calculations, it will be found that in many residences, the shades are kept half way down at all times, and if venetian blinds are fitted, these are invariably kept down the full length day and night, with the slats tilted, more or less, to meet individual taste. With the glass partly covered in this way, and the addition of drapes which are often of heavy material, the heat loss from windows is reduced considerably. Even when dealing with cases where shades and drapes are not used, it is only necessary to compare the conditions which exist in one or two of the common methods of heating to realize what difference can exist at the average window.

With a radiant heat system the windows are invariably situated away from the heated surfaces, and the only warm

medium in contact with the glass is the air of the room, which is comparatively still, or moving only slightly, and usually at 70F. Some of the heat rays from the heated panels and reflected rays from other surfaces may impinge on the glass, and some of these are again reflected back into the room, but broadly speaking, very little heat passes through the glass beyond that due to the difference in temperature of the air in the room and the air on the outside. This may be 70F — 0F = 70F for average conditions. Compare this with the conditions which often exist when steam radiators or convectors are used, as illustrated in Fig. 20.

Air Moves Over Windows

With steam heated units, it is not unusual to have air rising from the surface of cast iron radiators or leaving the grills of convectors at a temperature of 120 to 140F, and this warm air scrubs the glass surface as it rises over the entire window. Consequently, the conditions which we may have at the windows are a moving air current over the whole surface, and a temperature difference between the air outside and the air moving over the glass of approximately 90 to 100F, if we allow for some diffusion and mixing with cooler air. This makes a difference of over 35%.

If, with a radiant heat job, it is necessary to place some supplementary heat below large windows to prevent down drafts, then the air rising to the glass surface may be just slightly higher than that of the room. In these cases, however, it is only necessary to supply sufficient local heat to overcome the window effect, whereas with a cast iron radiator or convector system, the heating unit or units, must be of sufficient capacity to supply adequate heat for the entire room, and the temperature and volume of the air leaving these units will be correspondingly higher.

It is easy to understand, therefore, that if a value of 1.13 Btu per sq ft per degree difference is used for glass in making heat loss calculations to obtain the assumed heat emission from floor panels, and the percentage of glass is high compared with the area of walls and ceilings, this alone may be able to reduce the heat load requirements from the floor by about 12 to 15 Btu per sq ft of floor area. Then again, under normal conditions, it is found that the average surface temperature of all unheated surfaces in a room to which the heated floor may be exposed, is probably in the neighborhood of 63F, whereas if the total glass area is exceptionally large and the temperature of same is only 27F or 28F, as may be the case in zero or subzero weather, then a heated floor exposed to such cool surfaces could give off over 50 Btu per sq ft per hr at a surface temperature of 85 F, and perhaps over 60 Btu per sq ft per hr in extreme cases if the surface is raised to 90F, without departing from what we now recognize as the theory associated with radiant heat. It must be understood, however, that these latter figures are possibilities based on assumptions that may or may not exist in a particular type of building, and certainly not in a room designed for human comfort.

Care Required in Use of U-Values

I would like to point out to beginners that although it may be possible to get 50 or more Btu per square foot of floor area under such exceptional conditions as was suggested previously and those shown in Fig. 21, it would be very unwise to apply such high figures to a residence, office, or classroom where the floor area will be exposed to warmer surfaces, and where comfort and health are of the greatest importance. There is always a danger in publishing high emission rates for exceptional conditions for fear that someone will inadvertently use these figures for the wrong application and immediately get into trouble. Hence the need of giving all the qualifying conditions when any exceptional figures are suggested. While I have endeavoured to show that by using what I consider a more correct, but still a liberal value for glass, we can reduce the anticipated heat emission from a floor by an appreciable amount, I think if the other U values used in these same calculations were corrected according to the actual losses, it would alter the equation and a balance found where the present theory concerning the heat emission from radiant heating surfaces would become increasingly clear.

It may also be assumed, with a very definite degree of accuracy, that the interchange of air will be less with a radiant heat system than with warm air and high temperature radiator or convector systems. This variation in the infiltration of air became very apparent to me when testing similar buildings with different methods of heating, especially high buildings such as churches, public buildings, and the like. Then again, since with hot air and other high temperature systems, the temperature gradient in the room is greater than with radiant heat systems, the air temperature near the ceiling or roof is very much higher than with a floor heating system, so that the anticipated heat load based on the older methods will, consequently be much higher than the actual load with a radiant heat system.

In making analysis of the available data upon which some of the conclusions were arrived at in advancing the claim that very high output ratings from floors can be obtained, it seems significant that in no instance have I been able to find any statement as to the actual interchange of air which takes place during such tests. Neither have I been able to find any accurate record of how the internal and external temperatures varied during these tests or before the tests were started. The thermal capacity of buildings varies considerably, and it is possible for some buildings to build up a considerable heat reserve before a test is started, and if this is not taken into consideration it will lead to most erroneous results and render a completed test not only useless, but also actually very misleading.

Experience at Liverpool Cathedral

As a case in point, I refer to the results obtained from the floor heating system at the Liverpool Cathedral. With the oil burner shut off, it took 36 hours for the air temperature in the Cathedral to fall 1F. This, of course, is an extreme case, since the massive masonry constitutes an immense heat reservoir, and the exposure losses are by comparison relatively small. Nevertheless, since this building can hold sufficient heat in reserve to maintain the air temperature practically constant for over 24 hours after the oil burners are shut off, it suggests that if the heat reserve in a building is not taken into consideration,

or the test conducted in such a way that this factor is allowed for, the results from this alone can be very misleading.

Down Draft from Windows and Skylights

I think it is advisable at this point to call attention to the fact that in some articles claiming higher output factors, it has been suggested that an additional allowance should be made for the extra heat given off from a floor because of the down-draft of air from large windows. While it is correct that air moving over a heated surface will increase the convection output, it must be considered that in doing so the surface temperature of the floor is reduced and the emission by radiation will consequently be reduced unless the surface temperature of the glass is very low and is directly exposed to the surface of the floor, so that the heat rays may travel uninterruptedly from the floor to the glass. This, however, is very doubtful, and even were this possible, there is a limit to which the increase of heat can be maintained, since this depends on the conductivity of the panel material and how rapidly the extra heat can be transmitted from the embedded pipes to floor surface.

I have made a number of tests with air moving over a heated panel at different velocities, and find that the increase in output depends on so many factors which cannot easily be calculated beforehand that the question becomes very problematical. It not only depends on the velocity, but also on the characteristics of the particular panel and the temperature difference, it also depends on the actual surface temperature and nature of the unheated surfaces to which the heated panel is exposed.

While some slight increase in heat emission may be gained by the air descending from a window above, I must remind readers that where comfort is essential, no heating engineer should leave a large glass window unprotected to allow a downdraft to take place. I have repeatedly called attention to the fact that even with radiant heat there is a serious danger of downdrafts if cold vertical surfaces or skylights are not taken care of. I have seen some very beautiful churches made very uncomfortable in winter because of this neglect.

Recently, I have had a very definite example of this in the general office at our plant in Bethlehem, Pa. During a very cold spell of weather last winter, I received complaints from some members of the staff occupying the general office that objectionable drafts could be felt from the skylights above. Since no previous complaint had been made during the eight years this office has been occupied, I immediately suspected air in the coils protecting the skylight. On inspection, this suspicion was justified.

Since it was not possible to vent these coils automatically, manually operated air valves were installed to vent the coils when starting up. The provision made for eliminating air from the water leaving the heat exchanger has proved sufficiently effective to prevent trouble for eight years, but gradually sufficient air found its way to these coils to stop the circulation.

Probably, this will now continue to operate satisfactorily for a few more years, but it does prove that air is not always absorbed by the water, and that air can reach high points and stop the circulation; it also proves that if large windows and skylights are not considered in designing any type of heating system, a lot of trouble may be expected.

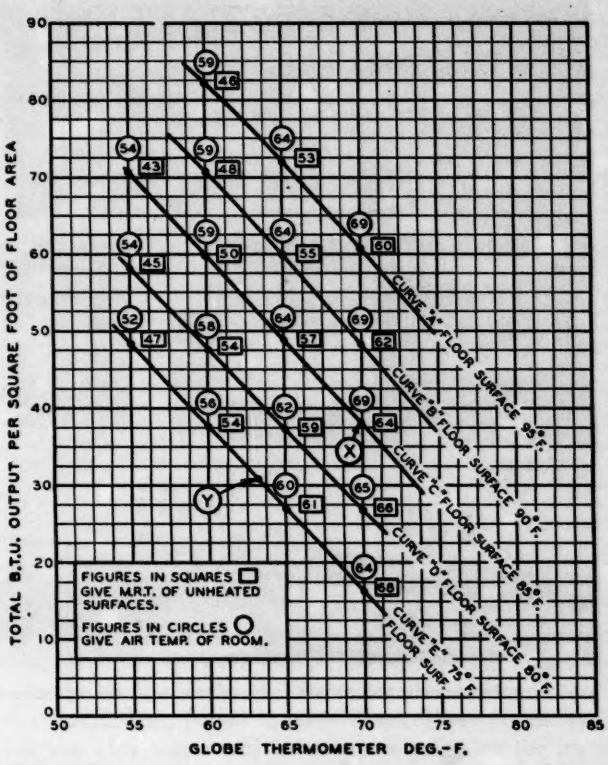
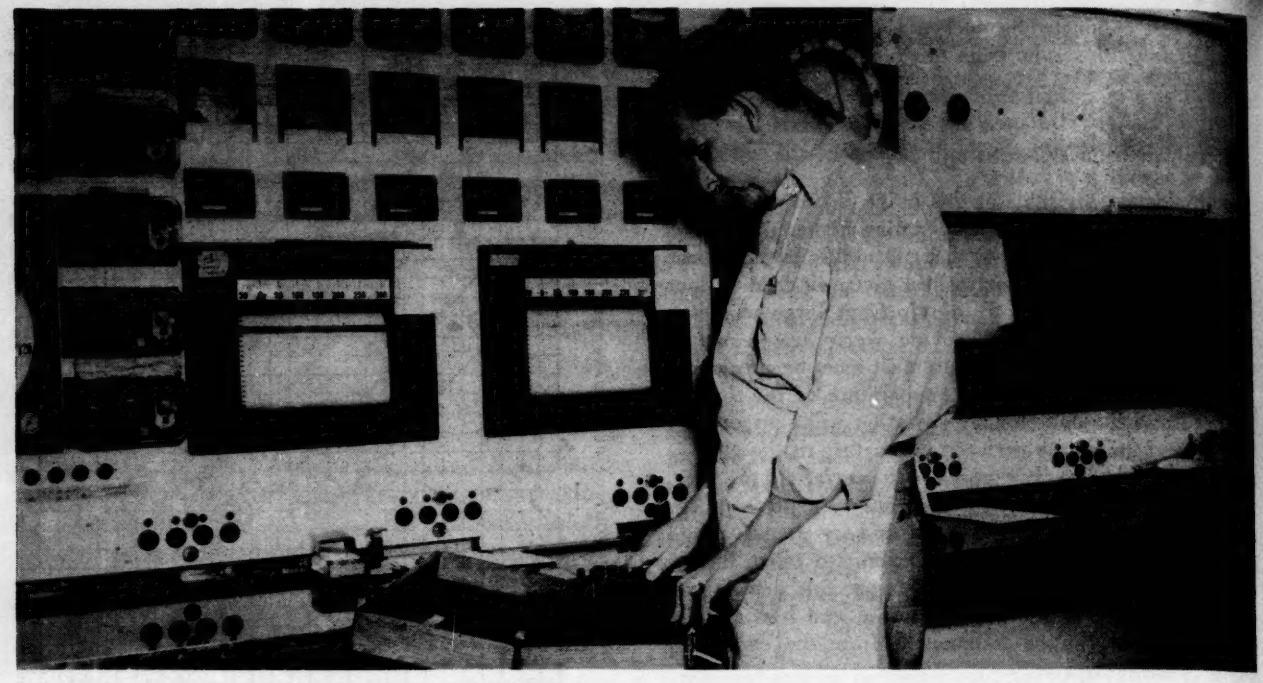

TOTAL B.T.U. OUTPUT PER SQUARE FOOT OF FLOOR AREA
GLOBE THERMOMETER DEG.-F.
FIGURES IN SQUARES □ GIVE M.R.T. OF UNHEATED SURFACES.
FIGURES IN CIRCLES ○ GIVE AIR TEMP. OF ROOM.
CURVE "A" FLOOR SURFACE 95° F.
CURVE "B" FLOOR SURFACE 90° F.
CURVE "C" FLOOR SURFACE 85° F.
CURVE "D" FLOOR SURFACE 80° F.
CURVE "E" FLOOR SURF. 75° F.

Fig. 21. Heat emission from concrete floor exposed to various temperature conditions.

If it is not possible to prevent downdraft with ordinary methods of floor heating, then some kind of wall or baseboard panel, or perhaps convectors, can be employed. With some types of workshops, unoccupied halls or showrooms, such downdrafts may be permissible, providing workmen or other occupants are not stationed within the area of air currents, but my advice to heating engineers who respect their reputation is don't take chances with churches and auditoriums where people congregate for any length of time and remain seated. Further, do not take chances with residences, schools and other buildings where comfort and health are of first importance.

Furthermore, while it is true that with a current of air sweeping over a warm floor the total heat output from the floor surface will be increased slightly, we must take into consideration the effect such a current of air will have on the ankles and feet of those sitting in the path of that moving air, even though they may have their feet resting on a warm floor. It has been my experience that whenever a downdraft does occur in a church or public auditorium, there is invariably a man with a bald head, and whenever a current of air is created over the floor you will surely find some ladies who are affected with cold feet. It never seems to fail!

In making these remarks, I am not advocating conditions which will promote stagnant air, but I am suggesting that a heating system should be designed so that cool air cannot move into a place where it will become very objectionable to occupants of the room. For many occupational jobs, we recommend a movement of air to prevent that monotonous feeling invariably due to stagnant air, but this should be designed and not left to chance.



Instrument technician E. H. Alldridge checking accuracy of temperature recorders on Humidity Test Room panel.

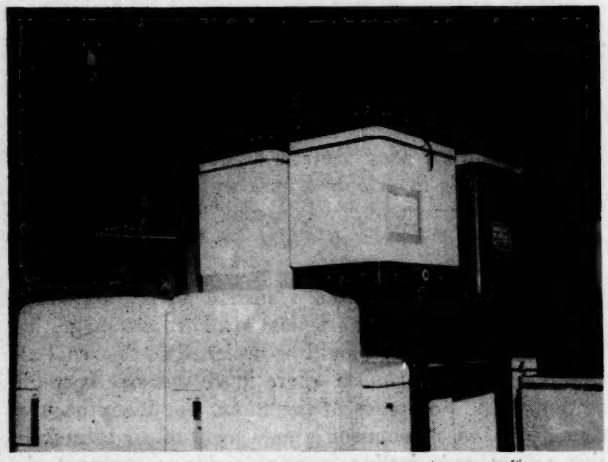
Instrumentation for Testing Refrigeration Products

H. R. BALL

Product Development Engineer,
International Harvester Co.,
Evansville, Indiana

Into the experimental and test laboratory of International Harvester's Refrigeration Division at Evansville, Ind., have been built hot rooms, a low temperature room, humidity room, sound level room, and calorimeter room, where a series of performance tests are run to check every possible function of household refrigerators, freezers, milk coolers and unit air conditioners.

TESTS for refrigeration products call for accurate control of temperature and humidity, precise recording of data, and a staff of experienced engineers and technicians. At International Harvester's test laboratory, full advantage has been taken of the latest advances in instrumentation to make these tests thorough, yet as rapid as possible. One hundred forty-three recording and controlling instruments, mounted principally on three centralized instrument panels are designed to facilitate the logging of all required data, without subjecting personnel to uncomfortably high or low temperatures, without entering test rooms and thereby upsetting room conditions, and to permit adjustment of automatically controlled conditions of temperature and humidity. Numerous types of Honeywell air conditioning controls are employed in the air conditioning systems for the test rooms.



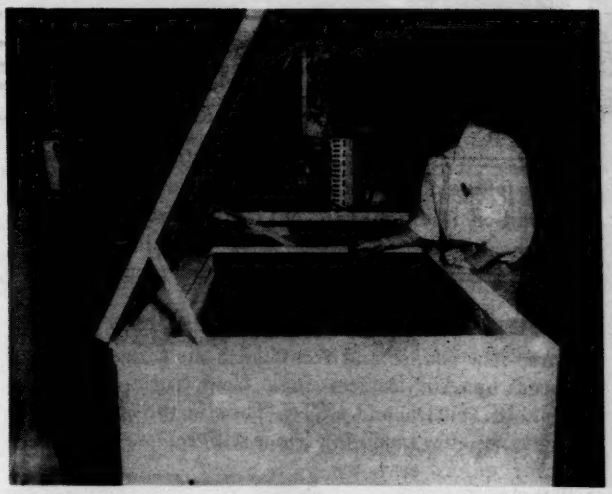
One of test rooms where refrigerators and freezer chests are undergoing general life test.

Window Conditioner Test Rooms

One important performance check on Harvester's new window air conditioner is the calorimeter test. This involves placing the conditioner between two test rooms thus providing a hot side and a cold side, with each maintained at accurately controlled conditions of temperature and humidity.

The hot side room is held at 95F DB and 75F WB (40% RH) while the cold side room is held at 80F DB and 67F WB (approximately 50% RH). The dry bulb

Technician checking effects on food after a refrigerator has been automatically defrosted. (Note thermocouples installed at various locations within the refrigerator.)



Ice Freeze Test on milk cooler. The time required to freeze a known quantity of water is determined in this test. (Indicating pressure transmitters on wall.)

temperatures are controlled by Brown circular chart recorders with pneumatic control, measurement being made by a resistance thermometer bulb; humidity is controlled directly by the new Honeywell electronic element connected to a circular chart recorder with pneumatic control.

In all, six new test rooms have been recently completed. These are equipped with individual duct-work and complete air conditioning systems. Each room has its separate recorder-controllers for temperature and humidity with a carefully integrated, sequence control interlock for humidification, dehumidification, heating and cooling. Wide use is made of pneumatic relays, electric-pneumatic relays, high limit controls and similar accessory equipment to make the system as efficient and fool-proof as possible.

One interesting instrument application in the system is the use of pneumatic-operated units which regulate the current supply to electric heating elements in the air ducts. Controlled air to operate this unit can come from either the dry bulb controller or the humidity controller, being interlocked through a pneumatic switching relay.

Controlled conditions are maintained in each room between which the window air conditioner is operated for the test. A recording kilowatt-hour meter provides a means of measuring the amount of heat added to the cold side by the current flow through the electric heating elements. At the same time a recorder measures the temperature difference across the cold water coils in the duct of the hot side by means of two resistance thermometer bulbs located in the inlet and outlet water line to the coil.

Together with the temperature difference record, water flow through the coil is metered to permit calculation of the amount of cooling required to offset the heat rejected by the test unit and auxiliary equipment. The two results —the measured heat added to the cold side and the measured quantity of heat removed from the hot side must check within six per cent. (The accepted test for capacity of the conditioner is based on measurements on the cold side.)

A number of other tests on the window air conditioners require automatic control of humidity and temperature, including tests for: (1) maximum loading, (2) condensate elimination and sweating, (3) low and high voltage operation, (4) Underwriters' specifications, (5) pull-down, (6) evaporator frost, and (7) low temperature operation. For these tests the dry bulb temperature and humidity controller set points may be varied over a wide range.

In the six new test rooms, thermocouple wire connectors are mounted on panels in each room. These permit the logging of a number of temperature points on the conditioner or in the room. The majority of individual thermocouple wire connectors in the calorimeter rooms (cold and hot sides) are permanently wired to 36-point selector switches (multiple bank type) which can be connected to an indicating portable type potentiometer through a 10-point selector switch. (Temperatures during a calorimeter test must be measured to ± 0.1F for accurate capacity calculations). Approximately 200 other thermocouple connectors in these rooms are permanently wired to thermocouple panels on the main panel board and can be connected to indicating or recording instruments.

Household refrigerators and milk coolers are tested in a large room known in our laboratory as the humidity test room, although many other tests are performed in it. The room has an air conditioning system similar to that previously described for the window air conditioners. Among the many tests conducted are those for (1) no load cycling, (2) load, (3) heat leakage, (4) maximum motor winding temperature, (5) life, (6) thermostat settings, (7) sweating, and (8) pull-down.

For certain of these tests NEMA standards require that the room temperature be controlled within $\pm$ 0.5F at control point (a height of four feet from the floor for refrigerators) and that stratification from floor to ceiling be less than 0.5F per foot. For temperature control here, circular chart potentiometers with pneumatic control are employed. Wet and dry bulb thermocouples are used because the system was installed prior to the development of the electronic humidity element.

In this room also, provision is made for multiple logging of temperatures on strip chart recorders, with selector switches provided to connect room thermocouples to the panel mounted recorders. In a refrigerator test, for example, from 6 to 20 thermocouples are used to measure such temperatures as (1) cabinet air in three locations, (2) air in the evaporator, (3) air in the chill tray, vegetable bin, butter conditioner, and the like.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite page 115 for securing additional information on items described in this department.

Three New Square Diffusers

Three new square and rectangular air diffuses are announced by Air Devices Inc., New York, N. Y., as models, RC, RCDF and RCTC. They feature built-in diffusing vanes, new mounting frame with removable diffuser core for quick, easy installation.

The simplicity of the method of installation eliminates costly unnecessary time consuming on the job operations. Only two quick steps are required by the installer: First, the mounting frame is fastened to the duct collar; second, the diffuser core is fitted into the frame and held securely with a turn of a mounting frame lock. When adjustment for air velocity is desired, or space conditions change and a different diffuser pattern is required, the diffuser core is easily removed by releasing the mounting frame lock.

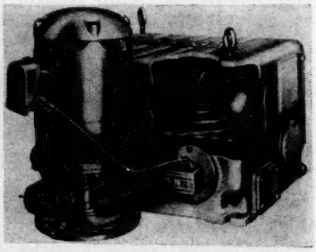
All of these diffusers are tailor-made to suit conditions of each application and are available in a wide range of sizes with vanes and louvres assembled in a variety of patterns to provide blows in one, two, three, or four directions.

Engineering bulletin RC-105 is available.

More information? Circle Item 1 on postcard, page 115

New Condensation Pumps

A new line of close coupled condensation heating pumps is announced by Hoffman Specialty Co., Indianapolis, Ind. These are available in types CS and CD as well as in the Watchman line. The former is available in both single and duplex types.



The types CS and CD employ a vertical drive, close coupled pump for alignment and accessibility. These pumps will operate a wide range of pressures and at the high temperatures encountered in condensation pump service. Bronze or other non-corrosive material is used in all submerged parts and the receiver is of cast iron. Renewable wearing rings also contribute to sustained service. The float switch mechanism can be removed as a unit and is easily adjustable to individual requirements.

The Watchman line is designed for low pressure heating systems, and features a 1/3 hp standard NEMA *C* flange motor. This pump occupies a floor space 18 x 24 inches. The motor and impeller assembly can be easily removed as a unit without disconnecting any piping. It has a one-piece bronze impeller, bronze packing gland, double pole float switch, and 12 gallon cast iron receiver.

The Type C pumps are available in capacities ranging from 1,000 to 65,000 square feet of equivalent direct radiation. The Watchman unit has capacities up to 8,000 square feet E.D.R. with a pump capacity of 12 gpm.

More information? Circle Item 2 on postcard, page 115

Coatings for Pipe, Ducts

A line of Ricwilite phenolic resin coatings for industrial applications has been announced by the Ric-wiL Plastic Coating & Mfg. Corp., Cleveland, Ohio. These coatings are specially formulated to protect equipment against extremely corrosive conditions in all types of industry with a tough, impervious film which is resistant to attack by corrosive acids and alkalis, salt water, rust, and weathering. The coatings are intended for protection of ventilating and duct systems, drill pipe, piping and equipment in food and chemical process plants, oil refineries, pulp and paper plants, sewage lines, tank cars, and storage tanks.

The coatings are available in two types, No. 1060, of the baking or heat-hardening type, and No. 7100, of the cold-setting type. The latter is cured at room temperatures by the addition of a catalyst prior to application.

Form S5251 is available.

More information? Circle Item 3 on postcard, page 115

Electric Side-arm Water Heaters

A new series of automatic electric side-arm water heating units for both domestic and industrial applications is announced by Electro-Therm Inc., Silver Spring, Md. The new units are rated from 1000 to 7500 watts over a range of 12 different models. Units are available for 115 and 230 volt service.

The heaters are intended for either original or conversion electric water heating installations. Their chief advantage is their adaptability to any size tank opening. The pipe fittings connecting the heater to the tank can be readily changed by the use of suitable bushings. Side-arm units can also be adapted to small tanks, and high wattages can thereby be utilized in cases where the space inside the tank is too small for the installation of direct immersion heating elements.

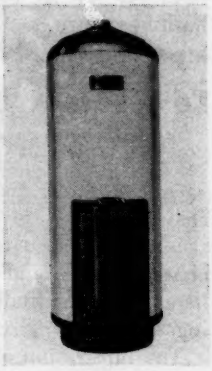
The heating elements are copper sheathed and have an integral thermostat that is adjustable over a range of 90 to 190 degrees. Relays or other auxiliary electrical controls are not required over the entire range of standard wattages.

Type RSA heaters, as the side-arms are designated, are described in the manufacturer's Data Sheet RSA-152, available on request.

More information? Circle Item 4 on postcard, page 115

Copper Gas Water Heater

An automatic gas water heater in which the water tank and the flue which carries the gases of combustion are made entirely of pure unalloyed copper, is announced by Trageser Copper Works, Inc., Maspeth, N. Y. At no point is water in contact with anything but copper.



The copper tank, from which the heater derives its name Copper Core, is surrounded by a heavy-gage steel wall, then Fiberglas insulation, and the outside baked enamel shell.

The combustion chamber is designed to afford a deep sludge well and insure minimum impairment of heating efficiency, even though sludge draining is neglected for unduly long periods.

The heater is made in 30, 45, 60, and 80-gallon sizes with recovery capacities of 21.8, 2914, 35.3 and 43.7 gallons per hour respectively at 100 deg. temperature rise. The heaters operate on natural, manufactured, mixed and LP gases.

Standard equipment includes Grayson Unitrol, a long-life burner with stainless nickel steel ribbon, and Rockwell gas pressure regulator on larger sizes when required. The latter is not provided when LP gas or LP gas and air are used as fuel.

More information? Circle Item 5 on postcard, page 115

Four Suspended Oil Furnaces

Four new sizes of suspended furnaces are announced by Quiet Automatic Burner Corp., Newark, N. J. They are Models 300, 400, 500 and 600, to bring the company's range of suspended furnaces from 70,000 to 240,000 Btu per hr.

Each unit is ready to install.

More information? Circle Item 6 on postcard, page 115

Zone Control with New Radiator

A radiator that provides low-priced room-by-room zone control is announced by Penn Boiler and Burner Mfg. Corp., Lancaster, Pa. Named the Penn Air-rad, it permits users to vary the temperatures of a room or group of rooms while adjusting only a single thermostat setting.

The radiator is intended for both the residential and motel markets. Low temperatures can be maintained in vacant rooms while maintaining higher temperatures in rooms occupied by guests. As each room is rented, temperatures are quickly raised from economy-level.

The units are sized to fit between standard studdings. Radiators are placed and tacked in place, thus cutting carpentry work to a minimum.

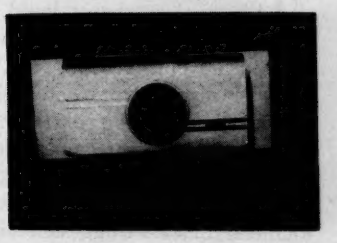
Only four sweat joints per radiator are required. There are no chain dampers, radiator dampers or air vent tanks.

The radiators are available in two models, 9,000 and 18,000 Btu per hour capacities. Roughing-in width of the smaller is 14 inches; the larger, 29⅝ inches. These two sizes meet all normal installation requirements. Radiator inventory can therefore be reduced. The larger model will heat two rooms.

More information? Circle Item 7 on postcard, page 115

Cooler for Casement Windows

A room air conditioner specifically designed for casement windows has been introduced by The Deering Air Conditioning Co., Cincinnati, Ohio. It can be installed in thirty minutes or less and requires no screws, bolts or brackets and the windows are not altered or mutilated in any way.



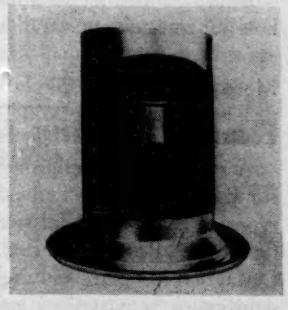
That portion of the casing which fits into the room, as shown in the illustration, contains the evaporator coil and the cooling fan. To the back of this portion of the unit are fitted two additional units with space between to allow for the column between the two halves of the casement window. On the one side is the compressor and on the other the condenser coil and condenser fan.

The conditioner is available in two models, ½ and ¾ hp, respectively. The latter model, G-75-2, has a ¾ hp compressor and a capacity of 9,000 Btu. Freon 12 is the refrigerant.

More information? Circle Item 8 on postcard, page 115

Diffuser Has Automatic Control

The Type A Flexiflo air diffuser designed to permit considerable variation in the quantity of air delivered without materially changing the radius of diffusion, is announced by Universal Diffuser Corp., New York, N. Y. It is equipped with an air cylinder attached directly to the shaft controlling the movement of the blades. With this cylinder hooked up to an air cylinder operating through a humidistat, automatic control is achieved.



By using a humidistat in series with a thermostat the volume of air can be reduced when the thermostat is satisfied but the humidistat is not. When the humidity becomes too high the effective area of the diffuser is reduced, thus cutting down the volume of air handled and at the same time reducing the outlet temperature of air leaving the coil.

The unit is also intended for maintaining constant temperatures through volume control at source of supply, especially in auditoriums, theaters and other large places where the load is subject to sudden changes.

More information? Circle Item 9 on postcard, page 115

Hood Protects Fan Exhaust

A ventilating fan with a protective hood combined with a magnet-locked shutter is announced by NuTone, Inc., Cincinnati, Ohio. The illustration demonstrates the fan hood mounted in brick or frame wall. The hood keeps rain and snow from blowing into the exhaust end of ventilating fans. The magnet-locked shutter in the fan is flutter proof.

A small magnet pulls the shutter closed when the fan is not in operation. It is held firmly in place against a felt pad lining the exhaust hood. In this position a tight seal is created preventing wind, rain, snow or insects from entering.

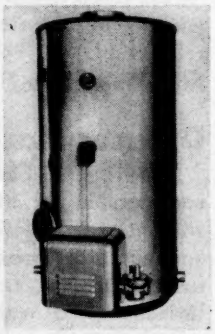
During operation of the fan, the shutter is pushed open by air pressure and swings freely. The metal hood is finished in a long-wearing, weather-proof enamel.

The fans are available in two sizes with 8 and 10 inch diameter blades. Suggested retail prices are $29.75 and $36.50, respectively. A three speed wall switch to operate these fans is also available.

More information? Circle Item 10 on postcard, page 115

95 Gal. Gas Water Heater

The Model 130G, a gas fired water heater of the large type is announced by Bock Corp., Madison, Wis. It has a storage capacity of 95 gallons and an output of 365,000 Btu per hour. It is said to be a fast recovery or instantaneous type heater intended for the large user of hot water and has a claimed efficiency of 80%.

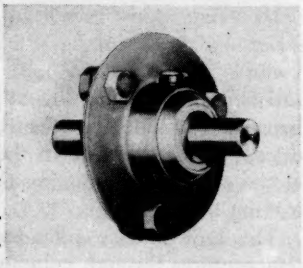


Applications include apartments, hotels, restaurants, and launderettes.

More information? Circle Item 11 on postcard, page 115

Flange Bearing for Sheet Metal

A compact, self-aligning, sleeve bearing unit designed for light shaft duty and power take off application on all types of sheet metal fabrications is introduced by Randall Graphite Bearings, Inc., Lima, Ohio. Air moving equipment is a typical application for this unit.



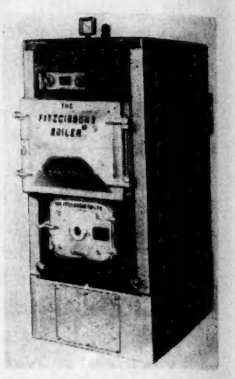
Flange mounting is made of 16 gage steel which is press-shaped to conform with the spherical shape of the ball assembly. Ball assembly is a machined cast-iron hollow ball in which an oil reservoir is formed when the bushing is pressed into place. Reservoir is packed with SAE No. F-11 wool felt which becomes saturated with oil as the reservoir is filled. Oil is fed to the bearing surface by the capillary action of sintered bushing or the graphited bushing whichever is required.

Bearing assembly measures 3½ inches in diameter by 1¼ inches and is available with sintered bushing for shaft sizes ½, ⅝, ¾, 15/16, and 1 inch and with graphited bushings in sizes ½, ⅝, and ¾ inch.

More information? Circle Item 12 on postcard, page 115

Low Water Line Boiler

An improved model of its R-Z-U Junior boiler is announced by Fitzgibbons Boiler Co., Inc., New York, N. Y. This new boiler incorporates improvements and design changes which give it greater salability, improved operating characteristics, and facilitate its handling and installation, cleaning and servicing on the job.



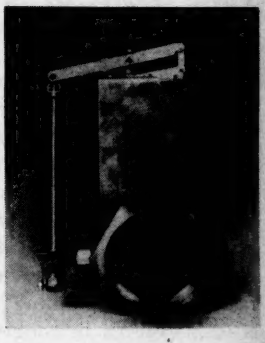
The illustration of this boiler, made in seven sizes with net ratings from 1100 to 3000 sq ft of steam (equivalent in hot water), shows some of the major changes, including a newly-styled heavy cast iron front clean-out and service door; side attached tray-cocks and water column tappings. A feature of this new boiler is the lower water line to permit of a greater market in the replacement field where low headroom is a deterring factor to boiler installation.

The new boiler will continue to be available with the company's Tanksaver domestic hot water heating coil for instantaneous hot water service in large volume for all types of requirements including kitchen, laundry, bath and launderette installations.

More information? Circle Item 13 on postcard, page 115

Air Operated Butterfly Valve

A pneumatically-operated butterfly valve for control of air, water or steam flow has been developed by the Industrial Division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.



The pneumatic valve motor is described as a Grad-U-Motor power unit. It operates on a controlled air pressure range of zero to 15 psi. Adjustable mechanical stops provided on the motor enable the wing rotation to be limited for special applications.

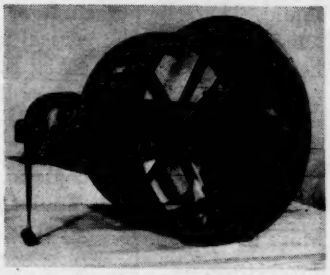
Valve is sized from 1½ to 6 inches, with screwed connections. Body, wing and trim material is bronze. Maximum operating temperature is 250 degrees F; maximum pressure, 20 psi.

An optional accessory is the company's Gradutrol relay for positive valve positioning on throttling control applications.

More information? Circle Item 14 on postcard, page 115

Belt Type Axial Flow Fans

A belt driven duct fan, the Macheta, in large sizes, has been made available by Aerovent Fan Co., Inc., Piqua, Ohio. These are available in sizes from 12 to 84 inches in diameter with 2, 4, or 6 blades. A 7 blade, semi-pressure unit is available in a limited number of sizes.



These belt-driven duct fans are primarily designed for extreme operating conditions for locations where it is desirable to connect a complete fan assembly, except motor, in the duct system. Typical applications would be the dissipation of acid fumes, explosive vapors, dust and gases.

A heavy gage steel drum with butt welded seam forms the housing for the cast aluminum propeller. Motor is mounted outside the duct on a rigid base and adjustable to provide for correct belt tension. Grease fittings are extended to points outside the drum.

The fans are designed with an air insulated belt and bearing feature. This feature insures protection to belts and bearings from extreme temperatures and acid conditions. Belt and bearing housing is open at the propeller end and on both sides of the duct permitting cool fresh air to pass over the belts and bearings, regardless of acid condition or temperature of the air being moved.

More information? Circle Item 15 on postcard, page 115

Control for Steam Systems

The Proportionator Control Type R-1 for vapor heating systems has been developed by Barnes & Jones, Inc., Boston, Mass. This system compensates for the amount of vacuum in the return line and other variables.

Control of steam which flows continuously to each radiator, is accomplished by using an orifice plate or adjustable orifice supply valve on each radiator or convector. In addition to the orifice, the system includes the thermal adjuster, control panel, governor, and flow control valve. The thermal adjuster is mounted on the inside of the outer wall of the building with the bulb fastened outside where it measures the exposed surface temperature. Change in the weather affects this instrument which in turn affects the control panel. The panel can be adjusted manually and also can be equipped with automatic night setback and fast morning pick-up.

The amount of steam pressure in the heating mains is measured by the governor which controls the motor-operated flow control valve, and the governor in turn is controlled from the control panel. The governor has two simple adjustments, one which sets the instrument to the particular climatic range at the point of installation; the other which adjusts the instrument to the specific building to which it is installed.

Advantages claimed for the system are continuous economy, comfort and low upkeep particularly in hospitals, schools, housing projects and commercial buildings.

More information? Circle Item 16 on postcard, page 115

Anti-Odor Activated Carbon

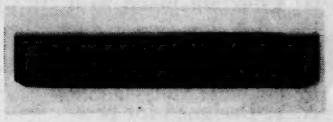
A new line of activated carbon equipment for air recovery and air purification is announced by Aerotrol Engineering Corp., Pittsburgh, Pa. Marketed under the trade name Nu-Air, the equipment removes odors from air and gases by adsorption of the odors by activated carbon. The company will provide numerous services in connection with activated carbon uses, in addition to manufacturing the equipment itself, and will also provide a reactivation service for all types and makes of activated carbon installations.

The equipment is available in cannisters or panels, in standard designs (illustrated) or special designs. Features of activated carbon equipment introduced by the company are said to include rugged construction and long life, plus great exposure of the carbon for high efficiency.

More information? Circle Item 17 on postcard, page 115

Perimeter Type Air Diffuser

A perimeter type air diffuser for heating and cooling, said to cut perimeter grille heating installation costs sharply, has been introduced by Titus, Incorporated, Waterloo, Iowa. Installation is made with the back of the grille flush with the wall and duct work leading to the grille comes through the floor and not through the wall.



These features are said to make possible savings in time and labor and that shorter ducts and less turns in the duct work are required. The diffuser merely slips over the boot.

Baffles on the inside of the diffusers throw air streams in a 180-degree arc so as completely to blanket the outside wall with warm or cold air, depending on whether the installation is for heating or cooling.

More information? Circle Item 18 on postcard, page 115

Industrial Type Fintube

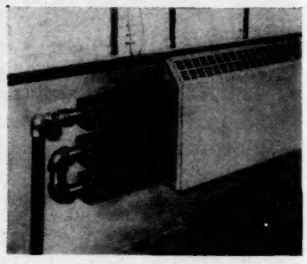
The Heavy-Duty Bayce-Heet, an industrial fin tube, is announced by Brown Products Co., Forest Hills, N. Y. It is made by a new process that eliminates tube expansion and the accompanying possibility of tube fracture at the weld. Instead of expanding and weakening the tube, the fins are beaded onto the tube, thus preserving the original strength of the tube. In addition, this process provides an undistorted bond for efficient heat transfer. Another advantage of this method is that the tube can be cut and rethreaded at any point.

The units are furnished with 32 thick fins per foot. This often makes it possible to secure the desired heating efficiency with fewer lineal feet of radiation. Each length is individually packed to provide the maximum in handling ease.

More information? Circle Item 19 on postcard, page 115

Fin Tube Radiator Enclosures

Fin tube radiators with enclosures tailored to engineers' specifications are said to be possible through the use of Custom-Fit enclosures, addition to the standard line of heating accessories manufactured by Radiant-Ray Radiation, Inc., New Britain, Conn. Designed for installation in schools, hospitals, office buildings and similar institutions, the radiation enclosures are available in standard units which are readily adapted to every known type of specifications. Six basic enclosure components are said to combine with the firm's Airfoil finned radiation elements to provide tailor-made heating installations for any steam or hot water job.

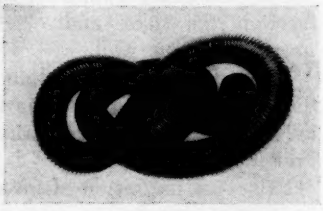


Installation of the new line is said to be simple and fast since all components are pre-cut and pre-punched to eliminate cutting and drilling on the job. Fasteners are concealed, corners are rounded and panel surfaces are smooth and unbroken. Heating element brackets permit expansion and contraction of the element, thus eliminating the danger of the bracket being torn from the wall.

More information? Circle Item 20 on postcard, page 115

Flexible Spiral Wire Duct

Development of a light weight, extremely flexible hose type ducting made with Neoprene compounds and laminated Nylon chafer duck, the Flexaust, is announced by American Ventilating Hose Co., New York, N. Y. Designed for pressure and vacuum services, this wire-reinforced ducting is intended for operations involving abrasive dust collection, heavy flexing and gravity feeds.



Uses on original equipment include those on refrigeration equipment, cooling electronic equipment, and exhaust duct on machine tools, while field applications include those in chemical processing, metal working, planes, mining and general contracting.

Size range is 1½ to 24 inches inside diameters.

More information? Circle Item 21 on postcard, page 115

Low Temperature Refrigerant

A new low temperature refrigerant, Kulene 131, is being distributed exclusively in the refrigeration and air conditioning field by Eston Chemicals, Inc., Los Angeles, Calif. The chemical name is bromotrifluoromethane (CF_3Br); it is non-toxic, non-explosive, and non-inflamable.

Advantages of the refrigerant are reported as: Lower compressor displacement than other commonly used refrigerants; lower compression ratio than other commonly used refrigerants; operating pressures sufficiently high to permit efficient operation of low temperature equipment; and specially suitable for small size low temperature equipment.

Properties includes the following: boiling point, atmospheric pressure, —73.6F; vapor density, 2.595 lb per cu ft at 5F, 9.365 lb per cu ft at 86F; density of liquid, 112.9 lb per cu ft at 0F, 96.9 at 80F; critical temperature, 153.5F; critical pressure, 587 lb per sq in; heat content of liquid, 22.32 Btu per lb at 80F; heat content of vapor, 50.25 Btu per lb at —40F; latent heat of vaporization, 53.8 Btu per lb at —73F; freezing point, —226F.

A technical bulletin containing tabulation of properties and other data and a Mollier chart are available.

More information? Circle Item 22 on postcard, page 115

Portable Industrial Fan

The Type PLDUP Power Line air blaster, a propeller type fan for industrial applications, pipe bending operations and similar uses has been introduced by Chelsea Fan & Blower Co., Inc., Plainfield, N. J. Unit is portable and can be moved by hand or crane. The fan has a totally enclosed ball bearing motor, direct drive, cast aluminum airfoil propeller with the propeller protected by heavy mesh wire guards at both ends.

The fan will operate with flexible canvas tubing and can be used as an exhauster or a blower. It is available in sizes from 18 to 42 inches in capacities from 6,600 to 34,000 cfm.

More information? Circle Item 23 on postcard, page 115

Two-in-One Hot Water Valve

An air valve for hot water systems is introduced by Keeney Mfg. Co., Newington, Conn. It shifts from manual to automatic venting with finger-tip regulation.

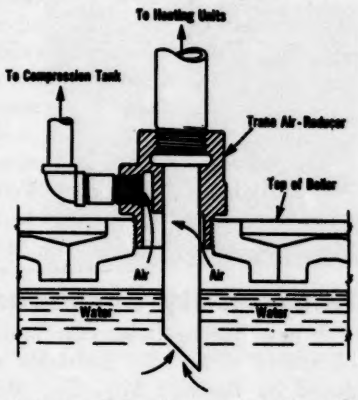
Named the Duovent, the unit is actually two valves in one. In manual venting, air escapes directly through a vent at the base. In automatic venting, a hollow pin blocks this route. Air escapes up through this pin and out through ports in the upper portion of the valve. Hygroscopic discs, which swell immediately when contacted by water, close the ports after air has been vented.

Changing from manual to automatic venting is accomplished by twisting the top half of valve. Unscrewing the top an eighth of a turn opens the manual vent. A similar turn in the opposite direction reseats the pin, placing the valve on automatic operation.

More information? Circle Item 24 on postcard, page 115

Bleeds Air from Water System

An easily installed fitting for removing air at the boiler of a hot water heating system has been introduced by The Trane Co., La Crosse, Wis. Design of the Air-Reducer eliminates two adapter connections, thus enabling easier, faster and more economical boiler installation. The device is, in effect, a pipe within a pipe. The brass inner tube extends the supply main below the surface of the water in the boiler, preventing air from entering piping and heating units. Air collecting at the top of the boiler is bled off to the compression tank through the outer casting.

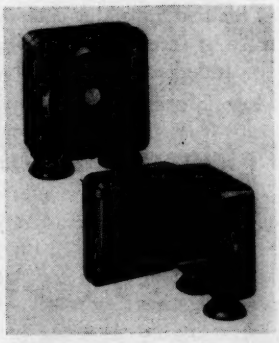


Further installation economies are gained through incorporating the boiler reducing bushing into the fitting, and through eliminating a nipple by fitting the device directly to the boiler. It is made for boiler and main sizes ranging from 1 × 1½ inch to 3 × 4 inches in standard increments.

More information? Circle Item 25 on postcard, page 115

Serviceman Thermometer

The Marsh Serviceman thermometer has been redesigned by its manufacturer, Marsh Instrument Co., Skokie, Ill., to provide an accurate testing instrument for use in testing refrigeration equipment and other installations where a temperature check is desired.



The steel case of modern design finished in metallic gray and black dial with sharp white numerals and hair-line aluminum pointer combine to give this instrument a handsome and dignified appearance. A molded clear polystyrene crystal protects the dial face and will not buckle or become distorted.

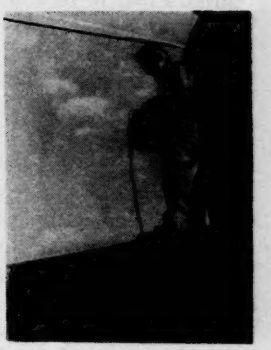
The internal mechanism has been reengineered; bourdon tube connections are fitted into female end pieces and silver brazed to form permanent leak proof joints while an internal stop provides complete protection against excessive temperatures, and a geared precision movement of wear-resisting brass insures long trouble free service. The Recalibrator, feature of the company's instruments, is no longer located on the face of the dial but has been shifted to the back of the reel plate where it is easily accessible. This change eliminates the necessity of having to remove the retaining ring and glass to reach the Recalibrator.

The range is minus 40 to plus 65 deg.

More information? Circle Item 26 on postcard, page 115

Plate Thickness Measurer

A magnetic fixture to hold a searching unit for determining the thickness of plates, tanks, pipe and other vessels is announced by Branson Instruments, Inc., Stamford, Conn. It is intended to be used with the company's ultrasonic Audigage thickness tester. The fixture allows one man to use the instrument since the fixture holds the searching unit against the plate or tank being tested and prevents accidental shifting.



The fixture consists of a flat spring with an Alnico permanent magnet coupled flexibly to each end, and means for attaching the searching unit quickly and easily to its center. The magnets are of sufficient strength to hold the unit properly against surfaces that are slightly irregular or covered with a thin coat of paint; heavier magnets can be provided for use on cast iron and other rough surfaces, or on plates that are covered with thick coatings of paint or scale. The standard fixture is only 5 inches wide and weighs 6 ounces.

Good contact is essential in ultrasonic thickness testing, because a frequency-modulated signal must be transmitted into the non-porous material and its frequency adjusted until it equals the natural frequency of the particular thickness being measured. Resonance then occurs, and is indicated by an audible tone and deflection of a motor; the actual thickness corresponding to the resonant frequency can be read from a conversion scale on the instrument panel.

More information? Circle Item 27 on postcard, page 115

Traps Stray Metal in Pipeline

A magnetic trap is being marketed by Tri-Clover Machine Co., Kenosha, Wis. The purpose is to trap out stray metal or tramp iron in process lines. It finds usage in the processing of chemicals, anti-biotics, pharmaceuticals, cosmetics and foods such as crushed vegetables and fruits, soups, juices, beverages, liquors, and many other chemical and food products.

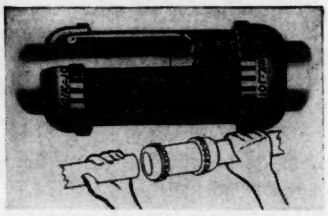
The trap features a grid type magnet having four or six pie-shaped segments, depending upon its size. This construction offers four or six magnetic gaps across which material can be trapped, as well as across the center of the magnet in any direction. This grid design is an improvement over the previous use of the horseshoe type magnet that has only one magnetic gap for trapping foreign metal.

Traps are fabricated of type 316 stainless steel, and are presently made in 2, 3 and 4 inch outside diameter sizes, in a variety of ends.

More information? Circle Item 28 on postcard, page 115

Joins Pipe Without Threading

A factory assembled pipe coupling which can be installed in any piping system in less than 60 seconds is announced by Quik-Joint Mfg. Co., Harvey, Ill. No thread cutting is required. Pipes to be connected are simply inserted into the ends of the coupling body and the lock nuts wrenched to desired tightness.



The result is a tightly sealed but flexible joint capable of withstanding working pressures up to 2,000 psi. No castings are used; the body is of pressure-tested pipe steel having a greater wall thickness than the pipe to be joined. Lock nuts and gasket retainers are drawn from cold rolled steel.

The coupling is for gas, water, air and oil lines, and is available in sizes from ½ to 1½ inch I.P.S. as straight coupling, 90 degree and 45 degree ells, welded and threaded adapters.

More information? Circle Item 29 on postcard, page 115

31/2 Lb. Magnetic Gas Valve

Addition of a 3½ pound capacity model to its line of magnetic gas valves is announced by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. It is designed for pilot line service on high pressure burner installations where pressurized pilots are desired.

The new high pressure valve, called the V495, is available for 115 or 230 volt service. It is available in ¼ inch and ⅜ inch sizes, featuring a hammer action plunger and a stainless steel cast into the valve body.

The hammer action plunger insures positive opening and closing of the valve at rated pressures. The stainless steel seat prolongs the life of the valve.

More information? Circle Item 30 on postcard, page 115

Stainless Steel Pipe Fitting

The Quikupl stainless steel fitting, a coupling designed to reduce assembly costs and to permit use of less expensive, lighter-wall stainless steel tubing, is announced by Peter A. Frasse and Co., Inc., New York, N. Y., and The Cooper Alloy Foundry Co., Hillside, N. J.

Chief advantage claimed for the new fitting is that it can be joined to tube or pipe without threading, flaring, sweat-soldering, brazing or welding, saving the cost of these operations. With this fitting, pipe or tube is simply cut to length, deburred, and inserted in the fitting. The coupling is completed merely by tightening a small screw.

By eliminating the need for threading, users of stainless steel tube or pipe escape the extra cost of heavy walls formerly required to take threads for screwed fittings. Furthermore, where industrial concerns already have changed to lighter-wall tubing, these fittings will materially reduce the high cost of flaring, fabrication, or welding which ordinary tube fittings heretofore necessitated.

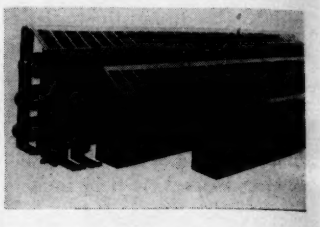
In design, the new stainless steel fittings resemble standard elbows, tees, ells, and other universal shapes, with the addition of a clamp which is an integral part of the fitting. Pipe or tube is inserted into the fitting and only one tool, a simple hex wrench, is needed to tighten the clamp.

The fittings are made in tees, couplings, 45° and 90° ells, and adapters in Types 304 and 316 stainless. Other types are expected to be added to meet demand.

More information? Circle Item 31 on postcard, page 115

Heavy Duty Baseboard Units

A new line of Basevector industrial and commercial circular steel fin tube perimeter radiators is being produced by Baseline Mfg. Co., Minneapolis, Minn. The sizes are 1½ inch pipe size with a 3½ and 4¼ inch O.D. fin and 2-inch pipe size with 4½ and 5-inch O.D. circular fin, in lengths up to 21 feet.



The spiral fin is heavily crimped at its base and the expanded outer edge creates a clamping action of the fin against the pipe. The pipe is standard and if necessary can be readily cut and threaded in the field.

Enclosures are attractive in design as joining strips are on the inside of the cover and are held in place by tongues and spring clips. The two piece heating element and enclosure hanger permits the heating element to expand laterally without noise. The heating element bracket is hooked into the enclosure hanger without the use of tools or screws, thus saving labor in making installation. Expanded metal enclosures are also available.

More information? Circle Item 32 on postcard, page 115

Refrigerating Oil Additive

Said to be the first lubricating oil additive for refrigeration equipment, Addit 88 is being marketed by The Sealed Unit Parts Co., Inc., New York, N. Y. The product has been tested for the past year and a half in the company's testing laboratories.

The highly penetrating film of additive prevents the formation of carbon and sludge deposits on bearing surfaces and will increase the film strength of the oil as much as seven times its normal strength, it is claimed. It will also remove deposits of carbon and sludge if they have already formed on bearing surfaces, thereby eliminating the necessity of complete overhauls.

Once added to a refrigeration system the additive remains there for the life of the unit. It is effective over a temperature range of —60 deg to 600 deg and serves as a lubricant coolant. It contains rust solvent and corrosion inhibiting ingredients, but is neutral to all refrigerants. It is used in expansion valves, two temperature valves, etc.

More information? Circle Item 33 on postcard, page 115

Removes Welding Discoloration

A method for removing heat discoloration from welded seams has been developed by Armco Steel Corp., Middletown, Ohio. It is especially effective on hard-to-get-at inside corners of sheet metal work.

This electrolytic process is reported to be superior to the original D-C process, and is simple and inexpensive to set up and operate. An alternating current power source is used. Equipment consists of a short length of copper rod, some rubber tubing, electrical wiring, clamps, a small step-down transformer, and a solution of 50% phosphoric acid.

Discolored weld seams can be treated at rates of two to four feet a minute with the proper set-up. The process leaves the weld area clean and bright, free of discoloration and light scale.

More information? Circle Item 34 on postcard, page 115

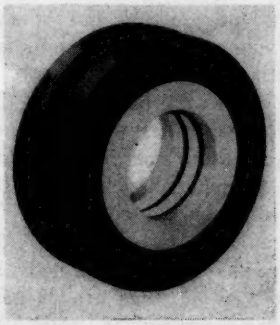
Diffusers for Acoustical Ceilings

In a description in last month's issue of the Modular Multi-Vent, a ceiling air diffuser panel introduced by Multi-Vent Div., The Pyle National Co., Chicago, Ill., it was incorrectly stated that "no air movement in excess of comfort zone requirements exists more than 6 ft. away from the panel." This statement was in error and should have read "no air movement in excess of comfort zone requirements exists more than 6 *inches* away from the panel.

More information? Circle Item 35 on postcard, page 115

Flexible Pipe Couplings

A new adaptation of the Teflon bellows used in its expansion joints is announced by United States Gasket Co., Fluorocarbon Products Div., Camden, N. J. It is the Chemiseal flexible coupling, composed of a bellows with only two convolutions, assembled with flanges of either cast iron, aluminum or special metals, and embodying integral gaskets.



These flexible couplings are suitable for connection to any of the major manufacturers' flanged-end designs of piping. Not only are these units suitable for joining piping of equal material, but also for joining such materials as Pyrex piping to glass-lined steel, and glass-lined steel tube to Karbate, Haveg and steel pipe. These couplings also make the use of adapters unnecessary, eliminating the need for slip joints, and taking the place of gaskets at the point of use.

The couplings are advantageous in absorbing vibration between pumps and piping; to compensate for slight misalignments of piping and equipment outlets; to accommodate slight movement of piping when connecting to scale tanks and weighing devices; to absorb a minimum degree of axial thermal expansion.

More information? Circle Item 36 on postcard, page 115

Grilles Have Deflected Louvers

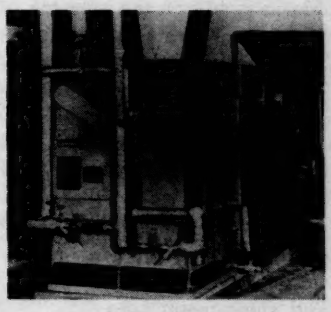
An important new feature in its Series 20 baseboard return air faces and its Series 10FG flat sidewall grilles is announced by The Lima Register Co., Lima, Ohio. The horizontal louvers on these two series of grilles have been deflected downward 23° to avoid the possibility of looking between the louvers at the unsightly stackhead or building construction behind the grilles. This change of the horizontal louvers has no affect on the free flow of air through the grille.

Other than this, there is no change in the basic quality or design of these units, nor is the selling price increased.

More information? Circle Item 37 on postcard, page 115

Sub-Freeze Air Dehumidifier

The demand for continuous and increased production which involves use of air at sub-freezing temperatures has been met by the Kathabar Division, Surface Combustion Corp., Toledo, Ohio, with a newly-desingle low-temperature package unit for humidity conditioning. This new equipment provides for continuous delivery of air at temperatures ranging from 32F to as low as —100F. The unit is a modification of the conventional Kathabar package unit for obtaining low absolute humidities.



Confectionery, pharmaceutical, military gun and jet powder, aircraft, laminated safety glass and other industries have required air conditioning equipment which could deliver air continuously at below-freezing dewpoints.

The new low temperature package unit now provides for an increased air moisture-absorbing capacity through utilization of refrigerants in its cooling coils. Such refrigerants include calcium chloride brine, methanol, ammonia, Freon, and chilled water. If desired, dewpoints considerably below the air temperature can be obtained. Refrigeration equipment is enabled to operate continuously at maximum efficiency without shutdowns for defrosting.

Air capacities for these units range from 1350 to 5000 cfm, capable of removing 30 to 290 pounds of water per hour from air. Conventional utilities are required. The unit is all on one base, measuring for the largest size approximately 48 x 108 x 66 in.

More information? Circle Item 38 on postcard, page 115

Refrigerant Condensate Pump

An automatic miniature condensate pump used to collect condensate in a refrigeration system has been introduced by Pump Division, Samuel S. Gelber Co., Chicago, Ill.

As the liquid drips or flows into the jar it will raise the float. At a predetermined level the miniature mercury switch will cause the pump to operate and empty the jar, carrying the liquid to a drain. The pump will not operate again until the jar is filled. Less service is required, life of the unit is increased and less electricity is used.

The jar holds 1 pint of liquid, the pump is all bronze, making the entire unit rustproof, and the cover is plastic. The outlet is ⅛ inch IPT and can be used with rubber tubing or standard water pipe.

More information? Circle Item 39 on postcard, page 115

Automatic Acetylene Torch

Savings in time, money and gas, and greater fire safety are reported for an automatic acetylene-air gas torch announced by Velocity Power Tool Co., Pittsburgh, Pa. The pistol-shaped Torch-O-Matic lights at the squeeze of the trigger and shuts off upon release, eliminating separate operation and equipment for relighting, manual valve adjustment, pumping or priming, and warm-up. It is said to be especially well-suited for intermittent work such as in many plumbing, heating, air conditioning, refrigeration, piping, and sheet metal jobs.

Squeezing the spring-loaded trigger simultaneously opens the torch gas valve and sparks the heavy-duty flint for ignition. Trigger also can be locked open for continuous flame. One-hand operation makes for better user comfort and efficiency.

The device, 12 ounces in weight provides instantaneous heat up to 2800 degrees. Combustion tubes are available in three sizes, ⅛, 3/16, and ¼-inch, and permit use of the torch for any air-acetylene job, from heavy soldering or heating to the finest precision work.

More information? Circle Item 40 on postcard, page 115

Pipe Insulation Improved

An increase in the density of Fiberglas preformed pipe insulation is announced by Owens-Corning Fiberglas Corp., Toledo, Ohio. Compared to its predecessor product of lesser density, the new product is firmer and more rugged, with greater ability to withstand the type of handling encountered in normal applications.

Despite the increased density, the product retains its lightweight qualities. Cutting and application are easy. The insulation does not cause corrosion and is not affected by moisture. It is odorless and provides no sustenance for insects, mold growth or vermin. The insulation has high thermal efficiency because minute, still air pockets, formed between the fine fibers of glass, provide high resistance to heat transmission.

The product is furnished in hemi-cylinders, three feet long, for pipe sizes ranging from ⅜-inch copper tubing through 12-inch iron pipe. Segments three feet long are furnished for iron pipe ranging in size from 12 inches through 33 inches.

Three types of jackets are furnished for the product. They include a close-weavemuslin cloth which minimizes the amount of paint required after application; a vapor resistant, foil-laminated type which makes the insulation suitable for use on dual-temperature and refrigerated lines; and a heavy waterproof roofing felt for use on outdoor installations.

More information? Circle Item 41 on postcard, page 115

Automatic Control Dehumidifier

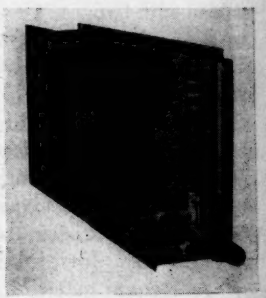
The Aqua-Sorber dehumidifier is announced by Walton Laboratories, Irvington, N. J. It is said to be the first dehumidifier to include an automatic control which saves on power consumption. An improvement over the customary timer control, the control is activated by the moisture content of the atmosphere. Thus the dehumidifier operates only when necessary rather than at timed intervals.

Other features include maximum air flow, easy removal of the water container and a hose connection readily accessible for permanent automatic water removal through drain piping. All models feature handy on-off switch.

More information? Circle Item 42 on postcard, page 115

Air Cooling Coils in Wide Range

A new line of air cooling coils, designed for use with 45 deg suction and suitable for use with Freon-12 and methyl chloride, is announced by Rempe Co., Chicago, Ill.



Coils are built with ⅝ inch copper tubes with seven aluminum fins per inch. Fins have ⅛ inch collars and are fully expanded to coil tubes. The coils are tested under 350 lb pressure, dehydrated and sealed. Casings are of heavy gage galvanized steel. The coils are furnished with multi-outlet expansion valves made-on, and are ready to install.

The coils have been sized for 80 deg inlet and 63 deg outlet air at approximately 400 cfm per ton and 500 fpm velocity. Air friction is .20 inches of water at 500 fpm. Standard sizes range from 2 to 15 ton coil capacity rating; available in 4 or 6 row coil assemblies.

More information? Circle Item 43 on postcard, page 115

PRODUCT INFORMATION SERVICE

Use the postage-free postcard below for further information on:

- **News of Equipment and Materials**
- **New Catalogs**

Circle the Item Numbers in which you are interested and print clearly your name and address with title.

NEW CATALOGS

AIR CONDITIONING SMOKE CONTROL
Ways and means to guard against panic and damage from smoke accidentally introduced into the air intake of air conditioning systems is the subject of Bulletin 521 issued by Ess Instrument Co., Bergenfield, N. J. The four-page brochure includes descriptions and diagrams of all three models of the company's smoke controls, including one that eliminates the necessity for wall break-throughs by flush mounting. A remote-reading model is also described and illustrated for installation where the main duct is some distance from the main fan controls. . . . **Item 44**

COAL CONSUMPTION SLIDE RULE
A slide calculator for use by coal company salesmen and engineers and by the personnel of coal-burning plants, for making fuel cost comparisons and for computing coal consumption from boiler outputs, is available from Bituminous Coal Research, Inc., Pittsburgh, Pa. It is easy to understand and is sufficiently accurate for most purposes. Examples printed on the calculator explain its operation. One side of the device permits quick fuel-cost calculations. The reverse side is used to compute coal consumption from boiler outputs for commercial and small plants, regardless of whether such outputs are expressed in pounds of steam, boiler horsepower, millions of Btu, or equivalent direct radiation. It is available at a list price of 50 cents each. . . . . **Item 45**

INSTRUMENT CATALOG
A new 42-page data book and catalog, TC-9, containing up-to-date prices, application recommendations and pertinent information concerning instrument sensing units and associated accessories has just been released by the Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill. Among the items listed are resistance bulbs and wells, radiation detector and special thermocouples . . . . . **Item 46**

HYDRAULIC CHECK VALVES
A new 2-page bulletin, WS-1, fully describing its hydraulic double cushioned check valves is available from Golden-Anderson Valve Specialty Co., Pittsburgh, Pa. Two detailed drawings show the complete list of parts. The application, construction, sizes and pressures are fully described. . . . . **Item 47**

CHARTS SPEED COIL SELECTION
Air conditioning coil selections can be made simply, accurately, and in a matter of seconds from a single chart, the Sicromatic chart, by use of a rule used with the chart and offered to architects, designers, engineers and contractors by Marlo Coil Co., St. Louis, Mo. Developed for the selection of coils for air conditioning applications using water or direct expansion refrigeration, the new chart-rule combination permits instant determinations of coil face area, air velocities, number of tube rows, required dry bulb depression, wet bulb depression and water velocity. . . . . **Item 48**

LOW TEMPERATURE INSULATION
A 16-page booklet, Form G21122, Specifications for the Application of Foamglas, in Low Temperature Space Installations, has been published by Pittsburgh Corning Corp., Pittsburgh, Pa. It contains information about the application methods on ceilings, walls, floors, columns and beams. It lists finishes, adhesives, sealers, suggested thicknesses, paints and properties of Foamglas. It can be used in temperatures from —35 to 50F. . . . . **Item 49**

FLOW RATE CONTROL
Bulletin 521 is published by W. A. Kates Co., Deerfield, Ill., on its line of flow rate regulators. The principle of operation employed by the regulators is illustrated. In addition, the literature describes a few of the many applications which have utilized these regulators at savings in installation and maintenance costs. . . . . **Item 50**

HOT WATER CATECHISM
A sixteen-page booklet listing and answering 52 typical questions, frequently asked, about good safety practice regarding selection, installation, and maintenance of safety valves and controls for domestic water supply and space heating, issued by Watts Regulator Co., Lawrence, Mass. . . . . **Item 51**

PACKAGED STEAM BOILERS
Bulletin 9100 covering its line of Scotch packaged boilers is available from Johnston Brothers, Inc., Ferrysburg, Mich. These boilers, fully automatic, are of the two pass, natural draft, waterback type with pressure atomizing burner for No. 3 or lighter oils. They are mounted on a structural steel base, interwired, interpiped and fire tested before shipment. They are available in eleven sizes with capacities ranging from 360,000 to 1,750,000 Btu per hour. . . . . **Item 52**

ANTI-ACID PIPE
Bulletin 139 has been published by Aqua-Therm, Inc., Dayton, Ohio and covering its line of Eonite pipe and fittings made of furan resin material and intended for handling mineral acids, alkalis, and organic solvents. The pipe is made in standard sizes from 2 to 12 inches in diameter and in lengths to 12 feet. . . . . **Item 53**

AIR DIFFUSING PANELS
Bulletin 385, 4 pages, has been issued by the Multi-Vent Division, Pyle-National Co., Chicago, Ill., and describing its new Multi-Vent low velocity air diffusing panels for acoustical metal pan ceilings. Various types of applications are illustrated and described. . **Item 54**

INDUSTRIAL DUST
Dust Dollars and Dividends is the title of a booklet prepared by American Air Filter Co., Inc., Louisville, Ky., and devoted to the matter of selling top management of industrial companies on the importance of dust. . . . . **Item 55**

COMMERCIAL WATER SOFTENERS
How soft water helps to reduce operating costs and increase profits is the theme of an 8-page booklet, Form 2239B, on why it pays to have soft water in restaurants. Prepared by The Permutit Co., New York, N. Y., the booklet describes some of the many distinct advantages of softening water supplies for use in restaurants, diners and counters. . . . . **Item 56**

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ADSORBENT CARBON

A 4-page bulletin, No. 132-652, has been issued by Pur Air, a division of American Solvent Recovery Corp., Columbus, Ohio, describing its line of gas adsorbent carbon equipment for air purification in food storage. ..... **Item 57**

ROTARY OIL-GAS BURNERS

An 8-page catalog in color describing its line of rotary burners has been issued by Superior Combustion Industries, Inc., New York, N. Y. These burners are designed for commercial and industrial use with any type of oil, as well as for operation in combination with any type of oil, as well as for operation in combination with any type of commercially available gas. Capacity ranges are from 5 to 167 gallons of oil per hour, or 17 to 560 boiler hp. Catalog describes features of construction, specifications, and capacity data. ..... **Item 58**

RADIATORS AND CONVECTORS

A catalog on its line of steel fin radiation, baseboard radiation, wall convectors, radiant fin coils, convectors, heat exchangers and condensers is available from Schemenauer Mfg. Corp., Holland, Ohio. The products include Hi-Vect wall radiation, a sloping top type convector, Steel-Fin radiation, Hi-Vect baseboard radiators of the flat front type, Super-Ray baseboard heaters with a perforated type enclosure and Panel-Ray fin radiators of the convector type. In addition, the Hi-Vect radiant finned coil is available for radiant heating, the coils being concealed in stud or joist spaces, intended for schools, apartments and commercial buildings. ..... **Item 59**

COOLING TOWER DATA

Bulletin 47-A has been issued by the Water Cooling Div., Binks Mfg. Co., Chicago, Ill. It describes the company's mechanical draft cooling towers of Types 2B, 2BB, and 3D, the first being a 3 to 30 ton blower type tower, the second a 32 to 60 ton blower type tower, the third an induced type of 1 to 100 tons. The greater part of the bulletin is devoted to the first two. Data include a chart showing performance data, complete specifications, a cut-away blue print of the tower, and a selection table for air-conditioning and related applications. ..... **Item 60**

INDICATING CONTROLLERS

Bulletin 1052 describing its Pulse Pyr-O-Vane indicating millivoltmeter controller, which provides time-proportioning control action and is designed for temperature control on electrically heated or fuel-fired processes where on-off or two-position controllers do not provide sufficiently close control, is a recent publication of the Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa. ..... **Item 61**

BROCHURE ON DUST CONTROL

Dust and fume control in process industries is the subject of a comprehensive brochure published by American Wheelabrator & Equipment Corp., Mishawaka, Ind. This booklet, Industry Relies on Dustube for Efficient Dust and Fume Control, tells how cloth-tube-type dust collectors are handling complex problems in 33 typical installations. ..... **Item 62**

NEW DIAPHRAGM CONTROL VALVES

Publication of a revised edition of the diaphragm control valve section, No. 105, of its climax control equipment catalog is announced by Black, Sivalls & Bryson, Inc., Kansas City, Mo. It shows photographs, sectional drawings and face-to-face dimensions of the new or completely redesigned items. Completely new is the Type 87 diaphragm control valve with bellows sealed stem. This valve is offered for use in chemical and other industries where even slight leakage of flowing medium might become obnoxious, dangerous or excessively expensive. Another new item is the Type 115 expanded outlet diaphragm control valve designed to provide a valve controlling flow of gases that require greatly increased volume upon release of pressure or liquids that are subject to a degree of flashing which would render an expanded outlet necessary. Also new is the Type 1486 three way diaphragm control valve which is designed for applications requiring change of direction, or partial splitting or mixing of the flowing medium in a system, as dictated by the controlling instrument. ..... **Item 63**

STEAM SYSTEM CONTROL

Bulletin R-1, 4 pages, describing its Proportionator control for vapor heating systems has been issued by Barnes & Jones, Inc., Boston, Mass. The system is described and illustrated. ..... **Item 64**

INDUSTRIAL DEHUMIDIFIERS

A 32-page bulletin, No. 222, Because Moisture Isn't Pink, issued by Pittsburgh Lectrodryer Corp., Pittsburgh, Pa., tells how dehumidifying equipment solves moisture problems for industry. Illustrated by 70 photographs and diagrams of actual installations, the bulletin describes production, handling and storage problems that were successfully solved by installing this equipment. .. **Item 65**

ELECTRIC HEATING ELEMENTS

Catalog 152, a 20-page illustrated publication covering its line of tubular electric heating elements, with and without built-in thermostats, for industrial, commercial, and domestic applications, is issued by Electro-Therm Inc., Silver Spring, Md. Standard units described include models with sheaths of copper, steel, stainless steel, Carpenter 20, inconel, and lead for heating water, oils, air, chemicals, acids, and other materials. The catalog includes useful data for selecting proper heating elements for specific applications, simple equations for calculating wattage requirements, etcetera. ..... **Item 66**

V-DRIVE CATALOG

A 44-page catalog on V-drives is issued by Maurey Mfg. Corp., Chicago, Ill. In the range of fractional to 10 hp. this book presents complete, easy-to-read descriptions, listings and price data on the bushed type and fixed bore type cast iron and pressed steel V-pulleys, Mor-Grip V-belts, refrigeration fans and fan pulleys. ..... **Item 67**

GAS UNIT HEATERS

Catalog No. 596 which describes and illustrates a new line of five gas-fired unit heaters with welded steel heat exchangers is being distributed by National Radiator Co., Johnstown, Pa. It shows essential component, cut-away, and full view illustrations of the new unit heaters which have an input range from 55,000 to 200,000 Btu per hour. .... **Item 68**

HEATERS FOR PROCESS USE

A revised edition of a 12-page bulletin No. 523-B, describing its Counterflo heaters is available from Dravo Corp., Pittsburgh, Pa. Principal addition is information on use of the heaters for eight other applications besides space heating. These are functional heating, process drying, temporary heating, medium temperature drying, tempering make-up air, drying vehicles after washing, crop drying, and integration with air conditioning systems. ..... **Item 69**

44-PAGE STEAM TRAP MANUAL

A new Steam Trap Book, designated as Catalog J and superseding its previous Catalog H, is issued by Armstrong Machine Works, Three Rivers, Mich. This 44-page catalog serves as a manual of recommended trapping practice. It includes: a trap catalog section containing complete physical data and list prices on the company's inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment, and a maintenance section explaining trap installation, preventive maintenance, troubleshooting and repair. Also included are numerous charts and tables relating to the subjects covered. ..... **Item 70**

HEATERS AND CONVERTORS

Two new bulletins, one on instantaneous heaters and the other on convertors, have been published by American District Steam Co., Inc., North Tonawanda, N. Y. The instantaneous heater bulletin No. 35-78, contains 56 pages, with 49 pages of tables. Most of the tabular pages are made up of capacities and pressure drops for 198 heaters through 12 temperature ranges and at 9 steam pressures. In addition to these, there are 13 pages of tables, illustrations and descriptive material on other heaters and coolers. At the end of the book is a monograph for determining steam consumption. The 32-page convertor bulletin No. 35-77 has 24 pages of tables with capacities and pressure drops for 148 convertors at 7 steam pressures and 15 temperature ranges. This booklet also contains a comprehensive dimension-weight-price table. ..... **Item 71**

PLEASE SEND US MORE INFORMATION. Circle below item numbers on which you wish further information.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71									

PLEASE PRINT Aug. H-52

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This card is void after November 1, 1952

What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

Conducted by
NATHAN N. WOLPERT
Associate Editor

THIS department is conducted in the hope that it may be helpful in solving troublesome problems faced by industrial plant engineers. Each month there is a discussion of the current problem and problems are announced that are scheduled for coming issues. Letters are welcome either from those who may have an industrial plant problem that they would like to see presented in this department, or from readers who may have comments that they would like to add to the coming discussions scheduled for future issues.

This Month's Problem

At times we have been adding copper sulfate to the water in our cooling tower to control algae and slime. We have been advised that our water, which is slightly acid, will in time attack the wood structure of our cooling tower. What is the general experience under such conditions. What can be done to prevent this?

Discussion of This Month's Problem

Copper sulfate has long been used for the control of algae and slime in cooling systems. It has limited solubility in alkaline waters but for the conditions described by the reader, its use is feasible. Under conditions where adequate concentrations may be employed, results have generally been satisfactory. Some instances have been reported when incomplete control of certain microorganisms has been achieved, requiring supplementary treatments with other algicides such as chlorine or sodium pentachlorophenate.

The optimum pH range for cooling system circulating water is dependent on the cooling system materials of construction, water supply and methods employed for control of scale, corrosion and biological fouling. Considering attack of the cooling tower wood only, current practice among many operators tends toward the maintenance of a pH range from 6.5 to 7.5. Recent surveys of a number of cooling towers show little chemical deterioration of the wood for towers operating in this range.

Most cooling towers are operated with high pH circulating water, either deliberately, in order to avoid corrosion of metal cooling equipment, or inadvertently, as the result of concentration by evaporation of an initially alkaline makeup water. With regard to the few that are operated at an excessively low pH (below 6.0), the limited evidence now available indicates that some chemical attack of the cooling tower lumber may be expected. To bring up the pH of the water to a more nearly neutral range, caustic or sodium carbonate may be added as required. Where the cooling water system is maintained acid, use of a suitable corrosion inhibitor is recommended.

Ernest Butcher,
Research Department
The Fluor Corp., Ltd.
Los Angeles, Calif.

Wood is slightly acid so a pH value of about 6.5 is optimum for redwood. A certain amount of hydrolysis may occur if the pH value is lower than this, but this acid condition will be more detrimental to the metal in the circulating system than it is to the wood in the cooling tower.

Most cooling towers operate at a higher pH value and the alkaline condition may be more detrimental to the lumber.

Donald R. Baker
Engineering Research
The Marley Co., Inc.
Kansas City, Mo.

The following information was taken from Progress Report of Technical Subcommittee No. 3, Cooling Tower Institute, on the Maintenance of Cooling Tower Lumber.

The destruction of cooling tower lumber, especially red-

Problems for Coming Issues

September Issue

We have a centrifugal pump which has a rating of 600 gpm. It has been in service for a number of years and the total head by gage measurement has increased six feet from its original 75 feet total head and at the same time the pump capacity has decreased. I suspect that the pump impeller may be at fault. If the impeller is the cause, can you suggest a means for correcting the trouble? If you believe there may be some other reason for this trouble, what can be done?

October Issue

How can you best apply an air stream around or over a door to prevent flies from entering a plant—particularly a food plant? Our immediate problem is an 8 ft x 8 ft wide open factory door which cannot be closed by screen doors.

wood has, in general, two causes which are called arbitrarily chemical attack and biological decay. Chemical attack can be explained from a consideration of the basic chemistry of wood and various components of the water which is circulated in cooling towers. Biological decay is caused by various micro-organisms, predominantly of the fungus family, although there are some indications that bacterial growth may contribute to this phenomenon. Considerable investigational work on both chemical attack and fungus decay has been conducted. The following general recommended practices for maintenance of cooling towers are presented in the light of the best knowledge to date:

For the control of delignification and possibly to some extent, fungal infection, cooling tower water should be kept at a pH preferably between 6.5 and 7.5. Although pH is not the sole criterion for delignification, conformance within the above limits should eliminate the constitutents in most waters which lead to delignification. Suitable corrosion inhibitors should be added to the water to protect metal equipment in accordance with accepted practice.

Where chlorine or bromine algicides are employed, residuals in the water should not be allowed to exceed 1 to 2 ppm in order to avoid the oxidizing effect of excess halogen (chlorine or bromine) on cooling tower lumber.

In most cooling towers, some algicide should be used for the proper protection of metal cooling equipment and the towers.

No recommendations can be made at this date for the elimination of fungus infections, with the exception that infected lumber when discovered should be removed immediately from the tower and replaced with new lumber. It is fully anticipated that the investigations now being conducted by the Committee will lead to satisfactory solutions to the fungus infection problem at a later date.

General good housekeeping is essential to the proper operation and maintenance of cooling towers. Proper maintenance of cooling towers should include regular periodic inspections, at which time scale and encrusted salt should be removed, water boxes, basins and screens should be thoroughly cleaned, and all debris and detritus should be removed.

Small Thermal Conductivity Probe Designed

The development of an electrically heated probe four inches long and .03 of an inch in diameter which, when modified, could be used for absolute measurements, was reported at the Spring Lake, N. J., meeting of the ASHVE by D. D'Eustachio, physicist, and R. E. Schreiner, technician, both with Pittsburgh Corning Corporation, Port Allegany, Pa., in a paper, "A Study of Transient Heat Method for Measuring Thermal Conductivity."

"In its present form, with stainless steel tubing as a protective sheath, it is difficult to use the instrument for absolute determinations. However it appears practicable to further reduce the diameter and heat capacity by discarding the metal tube. With this change absolute calibration to better than one per cent should be possible," they said.

Tests on cellular glass have shown good agreement with the guarded hot plate results and excellent reproducibility for a range of power outputs. Results indicate that any reasonable clearance between the probe and the insulation has little effect on the thermal conductivity determination. Manufacturers and users of insulation have for a long time needed a fast method for measuring thermal conductivity, a method which would have the precision of the guarded hot plate method while avoiding most of its problems.

"The basic criterion used in the design of the new instrument was that the temperature change in the material whose conductivity was being measured should be as small as possible," the authors explained. "It soon became clear that significant reduction in diameter was necessary if smaller temperature changes were to be used, and that changes in design were needed to attain the required reduction in size. It was necessary to keep the electrical resistance of the heater high and at the same time make the overall length of the heater short. This was accomplished by using a bifilar spiral wound of two mil constantan wire for the heating element. The clearance between the stainless steel housing and the spiral was made as small as possible. Care was taken to insure uniform spacing in the winding. Thermocouples, connected in series, were placed inside the coil.

"The actual steps in the construction of the probe were as follows: First, the bifilar coil was wound on a small diameter aluminum tube. A polyamide filament was used as a spacer. After completing the winding the spacer was removed and the coil was bound together with a thermosetting plastic.

"Then, the aluminum tube was removed by dissolving it with dilute acid. Next, insulated one mil copper constantan thermocouples were placed inside the coil. The heater and thermocouple assembly was then placed inside the stainless steel housing and was vacuum-impregnated with a coldsetting plastic. Finally, a plastic knob was cast at one end to act as support for the leads.

"The need for accurate measurement of a small temperature change as a function of time precluded the use of a manually operated potentiometer. Instead, a simple recording system was used. It consisted of a high-sensitivity galvanometer having a period of 1.3 seconds and means for recording galvanometer deflections directly on photographic paper mounted on a rotating drum.

"The optical arrangement was fairly conventional. The photographic paper used had a specially treated base to prevent dimensional change during processing. With this arrangement it was possible to measure temperature changes of .01F."

The authors said they were not confident the probe in its present form could be used for absolute measurements because there is no simple way of evaluating the effect of the non-radial heat flow. Improvement can be made by reducing the diameter and heat capacity and possibly increasing the length.

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Conducted by WM. B. FOXHALL, Associate Editor

Photoelectric Recorder Locates Pipe Corrosion

PROBLEM: Engineers of the East Bay Municipal Utility District in California were recently required to make a survey of a 94-mile stretch of water pipe in order to locate points of serious corrosion.

SOLUTION: General Electric photoelectric recorder was used to make electrolysis surveys. Because of the portability of the instrument, engineers were able to set it up in their automobiles as they made the corrosion tests. Each section surveyed was from 1500 to 3000 feet long and contained concrete structures with manholes through which wires from the recorder were attached to the pipe. Whenever a drop in current was found, corrosion was indicated and necessary repairs were made.

RESULTS: Due to the recorder's fast response, the engineers were able to determine the location of fluctuating stray currents and to take several feet of chart records to obtain an average flow. They said that the recorder had a definite advantage over an ordinary potentiometer-type instrument because it did not require constant balancing.

Dehumidifier Speeds Redecorating

PROBLEM: In many hotels and motor courts, the drying of paint in newly decorated rooms is frequently a factor in delay of room rental.

SOLUTION: Many hotels are using the new Fresh'nd-Aire room dehumidifier, a portable electric unit manufactured by the Fresh'nd-Aire Co. of Chicago, a division of Cory Corp. Users have found that wet paint can be dried and its odors removed in a fraction of the time previously required. The unit, although less than 2 feet in any dimension, can remove up to 3 gallons of moisture from the air in 24 hours. Weighing less than 60 lb, it may be carried from room to room and plugged into any standard light outlet.

RESULTS: In many cases, hotels can save up to a full day's revenue on a room by use of the dehumidifier.

Refrigeration Speeds Hormone Production

PROBLEM: Manufacture of Cortisone, Eschatin and Vitamin B-12 would not be possible on a commercial scale without the use of modern industrial refrigeration. According to Henry Desmond of Parke, Davis & Co., large quantities of refrigerated alcohol are used in the process of extracting hormones from animal glands.

SOLUTION: At the beginning of the process, animal glands are soaked in alcohol held at a temperature of 35F. Chilled alcohol is held in 500 gallon insulated tanks and may be cooled through a 50-degree range and held at 35F ready for use. Cooling of the tanks is handled by two Acme Flow Cold liquid chillers, each of which handles 15 gallons of alcohol a minute with 3 hp refrigeration capacity. Installation was made in the plant by maintenance men in a few hours. In a second production step, the alcohol containing extracts of glands is frozen to a solid state and sublimated under high vacuum. This process takes place in a double tank in which chilled ethylene glycol is circulated at minus 10F through the outer shell by a single 15-hp chiller.

RESULTS: Parke Davis engineers believed that the installation of packaged chillers was made in approximately one-half the time that would be required to install a conventional system. In addition, there were considerable savings in pipe, insulation, and other items which would ordinarily be essential to the project.

Paper Clamp Handles Pipe

PROBLEM: During erection of a new smoke stack in the publishing plant of the Watchtower Bible and Tract Society, Inc. of Brooklyn, N. Y., the problem arose of unloading 32 inch diameter, 20 foot long sections of the stack which weighed approximately 2100 lb each.

SOLUTION: The printing plant had in use, an Elwell-Parker roll paper clamp truck. The clamp truck was called into service to lift the sections of stack off the truck parked at the curb and carried them to the construction site. The clamp truck is designed to transport and store rolls of paper and is widely used throughout the printing industry for a variety of jobs.

RESULTS: A difficult unloading and handling problem was solved in an unusual and effective manner.

Snow Melting Steps Modernize Research Center

PROBLEM: In a modernization program for the Research Experiment Station of a major chemical concern in Wilmington, Delaware, it was desired to include a snow melting system in the flagstone approach consisting of 14 treads and two landings.

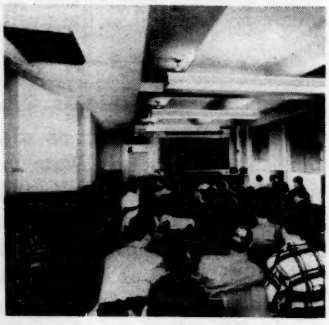
SOLUTION: Engineers removed the flagstone and scored the concrete to admit lengths of ¾ inch wrought iron pipe, product of A. M. Byers Co. An undercovering of a heavy mastic waterproofing base was applied after which the pipes were set in the grooves. Mortar was poured over the pipes to a thickness of 1½ inches. When the mortar had dried the flagstone treads and risers were returned to their original positions. A solution of hot water and anti-freeze is circulated through the pipe at a temperature of 160F during snow storms.

RESULTS: The system was used for the first time recently during a sudden 5-inch snow and melted the snow as fast as it fell.

Office Building Revamped for College

PROBLEM: When Long Island University acquired the eleven-story Brooklyn Paramount Office Building for its own use, the structure, which had been erected to contain ordinary business offices, needed extensive remodeling to make it suitable for college occupancy. The heating system was antiquated and no ventilating facilities, which are required for school rooms, were provided. Special equipment was also needed to meet the specialized requirements of the college's chemistry laboratories.

SOLUTION: The Gates Heating Company designed a series of fifteen separate heating and ventilating systems, all operating from the central steam supply and using, wherever possible, existing piping. Each system utilizes a United States Air Conditioning Corp. air handling unit with heating coil and delivers to its associated spaces approximately twice the air quantity required by regulations. Supply ducts are concealed in false beams. In the chemistry laboratories, specially designed fume-resistant exhaust ducts extend to individual grilles at each student's position at the work benches. High suction exhaust fans pick up fume-laden air at its point of origin and discharge it at a point above the building roof.



RESULTS: The college's classrooms, library and reading rooms are economically heated and ventilated by a series of independent systems operating in such a way that each section need be heated and ventilated only when it is in actual use. Fumes from chemistry laboratories are removed from the building by the shortest possible route through entirely separate systems.

Air Conditioning Boosts Hatchery Output

PROBLEM: At the Sales and Burke Hatchery in Riverside, California, conditions for holding newly laid eggs were found to be optimum at 55F and 80% R.H. Under these conditions, eggs can be held until a busy incubator is ready to start the hatching process.

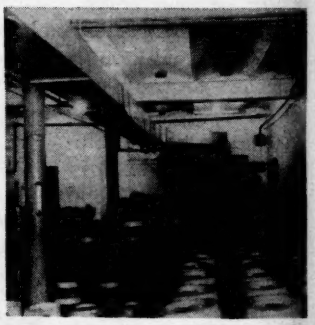
SOLUTION: A bank of Mitchell window type air conditioners installed through the walls of the storage space maintained ideal holding conditions. Thermostatically controlled units are mounted directly over large egg racks in a special insulated room.

RESULTS: With proper temperature control, one man can raise as many as 160,000 chickens in one year without investing heavily in expensive incubator equipment. Held at design conditions, hatchability of the eggs is raised between 10 and 20%. Holding of high quality of infertile eggs for eating purposes is also assured. After hatching, carefully balanced climate conditions provide a healthy, rapid growth, allowing chickens to be killed and processed after only 12 weeks.

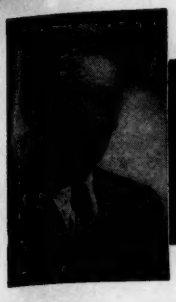
Brewery Brings Cooling Up to Date

PROBLEM: The Erie Brewing Company, one of the oldest breweries in Pennsylvania was undergoing a long range plant modernization program. Annual production capacity is 450,000 barrels a year, a 400% increase since 1933.

SOLUTION: The job of designing and installing new air conditioning and refrigeration equipment was placed in the hands of York Corp. engineers. Not only have the general offices been air conditioned but also all store rooms, packing cellars, and fermentation rooms. Twelve York industrial air conditioning units with fans totalling 54½ hp do the job formerly handled by miles of steel pipe coils. Four York ammonia compressors replace old steam driven compressors. These compressors allow for 12 steps of operation.



RESULTS: Air conditioning of production and storage departments has given the brewery new and effective economies of operation according to president J. M. Maganau, Sr. The air cooling units, creating greater cleanliness and drier rooms, have been partially responsible for what Mr. Maganau has held as his company's prime target: better quality beer.



Experience is my Classroom

By T. W. REYNOLDS

• ADVANTAGES OF BASEBOARD HEATING

I am in receipt of a letter from the Appleman Art Glass Works. They refer to an item on electric baseboard panels in my February, 1952 column and comment:

"A very interesting aspect of baseboard heating that was not mentioned in your column is the elimination of condensation on glass areas. This is important to owners of stores with display windows, also to home owners with large picture windows and glass walls. Elimination of condensation also prevents rotting of window frames and sills, paint peeling and other moisture damage."

To this I add that 17 years ago when I built my home on the Hudson River, I included a den or study. It had concealed radiation (more than calculated), a cold roof and floor, and very cold glass windows on its three exposed sides. You could sit in the center of that room at temperatures above 70F and be comfortable only with the sun at full blast and the outdoor temperature above 50F. It soon became only a summer room. At other times the nearer you went to the outside walls the colder you became, whereas in many a home with continuous baseboard heating, the nearer you go to the exposed surfaces the greater the feeling of warmth.

• PEAKS AND VALLEYS

A thorough study of operating peaks and valleys in an industrial plant often results in a less costly design. Boiler plant equipment and piping can be safely reduced in size, and production output increased in quantity and quality. Safety valves discharge less often and combustion at boilers can be maintained steadier and at a more efficient point. The boiler even lasts longer.

Many different processes in a plant help in lowering peaks and raising valleys. It is often an error, however, to consider that two or three processes are never coincident. Unless their timing and demand requirements are well known and fully arranged for, one may become surprised by finding all occurring at once.

Small peaks cause other peaks. For example, two processes come on at once reducing the steam pressure in the joint supply main. Immediately, someone opens wider the supply valve to the process in order to obtain results at the lower pressure. This causes a further drop in pressure due to the greater flow at increased specific volume.

When satisfactory boiler pressure is finally raised, everyone closes the valves to a certain extent, but boiler pressure still raises for a time. Due to less demand and less pressure drop with higher pressures, the valves are still further closed. Peaks and valleys become accentuated. Meanwhile, temperatures at processes vary and so does the quality of output.

Peaks of long duration can often be smoothed out by a careful consideration of all factors. Those of short duration are more difficult to adjust, but sometimes they can be reduced through proper measures to lengthen their duration.

• OVERSIZING MOTORS

Motors are one of the things we can and often do get too big. For example, a boiler maker passes on his requirements regarding the capacity of an induced draft fan to the fan maker who, in turn, passes along his own requirements to the motor manufacturer. The boiler maker has added a margin of safety to avoid possible complaints from his customer, the fan maker did likewise to make certain that the boiler maker would be happy. To all this the motor manufacturer completed the pyramid of safety with his own margin to insure absence of complaints from the fan maker. The result is an oversize motor which will run cool and without breakdown, but which will also run into money for first cost. Annual depreciation and obsolescence charges will also be greater on large items.

These remarks pertain more particularly to motors about 15 hp and larger. Below 15 hp, the reverse is usually true. For example, a 5 hp motor is most efficient at full load, but a larger motor at half load may be more efficient than the 5 hp motor. The larger motor at light load may take less power. It may also have a better power factor and but little speed reduction. A study of motor characteristics under various loadings is interesting and shows the possibility of carrying fewer spare motors. For example, instead of stocking motors of 3 hp and 5 hp, only those of 5 hp might be kept on hand.

• SAVING STEAM BY WASTING IT

Not long ago I visited an industrial plant where some of the steam using processes were rather intermittent. When a process was suddenly stopped, the back pressure on the plant rose to the point where much more steam was required to operate the steam engines. This in turn increased the back pressure and again the use of steam increased because of the back pressure. Then, as the boiler pressure dropped, due to greater steam usage, the governor on the steam engine opened wider to use even more steam.

Where a process or processes are more or less constant the back pressure valve can be set to occasionally relieve any small amount of excess back pressure. However, in the plant in mind it would be more economical to open the safety valve as a process is stopped and waste the steam to prevent any back pressure rise.

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

HANDBOOK OF ENGINEERING FUNDAMENTALS

Back in 1936, Dr. Ovid W. Eshbach and a large group of specialists were responsible for the Handbook of Engineering Fundamentals, a book that was somewhat of a departure from the general presentation of technical information. In coming out with the second edition of this well-known reference book, the entire volume has been reviewed and revised.

In the treatment of mathematics, some of the simple and commonly known items that were used for completeness of text, have been eliminated. The section on fluid mechanics has been divided into two parts and completely rewritten—one part covering the mechanics of incompressible fluids and the other aerodynamics. However, the section on thermodynamics is essentially as it is in the first edition.

One of the purposes of this book is to present a ready reference to the basic ideas of applied science and mathematics for those studying the subjects and for those who wish to be brought up to date on fundamental concepts.

Dr. Eshbach, editor, is Dean of Northwestern Technological Institute, Evanston, Ill. He was aided by a staff of 38 contributors.

Handbook of Engineering Fundamentals, Ovid W. Eshbach, editor. Flexible binding, 5½ x 8¼ inches, 1,315 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $10.

TECHNIQUES OF PLANT MAINTENANCE, 1952

The American Society of Mechanical Engineers and the Society for the Advancement of Management jointly sponsored technical sessions that were held concurrently with the Third Plant Maintenance Show at Philadelphia, Pa., January, 1952.

This 1952 volume is a complete transcript of formal papers delivered at this conference and it also contains the questions asked and the answers given by the speakers. However, it does not include the 15 off-the-record round table conferences that were held to encourage free discussion and which, therefore, were not recorded.

The volume contains 22 papers that were presented by men experienced in maintenance and management.

Techniques of Plant Maintenance, proceedings of technical sessions. Cloth bound, 8½ x 11 inches, 182 pages. Published by Clapp & Poliak, Inc., 341 Madison Ave., New York. Price, $6.

THERMAL PROPERTIES OF BUILDINGS

The property which is most obvious to persons living in temperate climates is the loss of heat which takes places from the building to the outside air during the winter months. However, it has been only within comparatively recent years that special attention has been paid to the thermal properties of building materials and structures. New building design and the use of new materials has brought with it the need to know more about the thermal properties of both.

N. S. Billington, the author of Thermal Properties of Buildings, is head of the National College for Heating, Ventilation, Refrigeration and Fan Engineering, London, England.

The subject matter is divided into the following nine chapters: The steady flow of heat, the unsteady flow of heat, comfort and warmth, pattern staining in buildings, condensation, solar heat and its exclusion, thermal insulation, the warmth of floors, and the heating system and the building.

Thermal Properties of Buildings, by N. S. Billington. Cloth bound, 5½ x 8½ inches, 208 pages. Published by Cleaver-Hume Press, Ltd., 42a S. Audley St., London, W.1, England. Price, 25s.

• • •

NONMETALLIC GASKETS FOR PIPE FLANGES—Sponsored by a group of engineering societies, the American Society of Mechanical Engineers has published ASA B16.21-1951 on Non-metallic Gaskets for Pipe Flanges. This 8-page booklet has a table of dimensions and a group of design formulas. American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, $1.

U. S. CENSUS OF BUSINESS—1948—Bulletin 3-13 has been issued by the U. S. Department of Commerce on the U. S. census of business—1948 for the hardware, plumbing and heating equipment trade. This report of 150 pages presents a large amount of statistical information pertaining to this field. Superintendent of Documents, U. S. Government Printing Office. Washington 25, D. C. Price, 40 cents.

STUDY OF FUELS—Walter H. Voskuil, Professor of Mineral Economics, Department of Mining Engineering, University of Illinois, has prepared a 28-page report on Economic Study of Fuels in Manufacturing. This report, listed as Circular Series No. 63, covers a general survey of fuels used in manufacturing, fuel costs, fuels and power in the iron and steel industries, and also in various basic manufacturing fields. It has 26 tables which present a wide variety of concisive information pertaining to the subject. The Engineering Experiment Station, University of Illinois, Urbana, Illinois. Price, 40 cents.

ALUMINUM NOMENCLATURE—The Sheet and Extruded Products Divisions of The Aluminum Association have jointly published a 20-page booklet which defines the sheet and plate products and also the miscellaneous terms that are used in the industry for both sheet and plate and also extruded and tubular products. The Aluminum Association, 420 Lexington Avenue, New York 17, N. Y.

ANOTHER CASE OF *Copper* WHERE IT COUNTS

Designers, architects, contractors and builders tell us that in many cases there simply is no adequate substitute for copper. As a result they are using what copper they can get where it counts most. One of those places is in hot and cold water lines in homes like the one shown. This installation required 90′ of ¾″ and 160′ of ½″ Revere Copper Water Tube, Type L. This National Award Winning Home was built by Jere Strizek. Designer was John W. Davis, both of Sacramento, Cal. There are more than 100 similar homes in the Town & Country area where this house was built. Plumbing contractor for 31 of the homes (all of which contain Revere Copper Water Tube) was Beckes & Anderson, Carmichael, Cal.

Next time you build, plan, specify or install, make sure Revere Copper is used in the spots where enduring performance counts most. The architects, builders and contractors who do have found it pays dividends in prestige, reputation and customer satisfaction.

See your Revere Distributor. He will advise you of the availability of materials and, in the event you wish to discuss your technical problems, put you in touch with Revere's Technical Advisory Service.

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WHY REVERE COPPER WATER TUBE IS PREFERRED BY—

Architects, Builders, Plumbing & Heating Contractors

EASY TO BEND

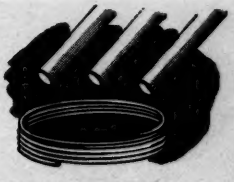
Saves Time

Revere Copper Water Tube is easy to bend. Soft temper can be bent by hand. Hard temper by hand bending tools.

HANDY LENGTHS

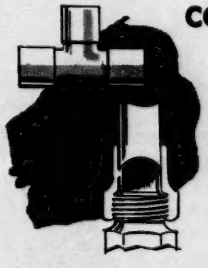
Save Fittings... Labor

Revere Copper Water Tube comes in straight lengths of 20′ in hard and soft tempers. 60′ coils of soft temper reduce the number of fittings needed.



SOLDER OR COMPRESSION FITTINGS

Need Less Work Room ... Save Metal



No worry about wrench room when you use Revere Copper Water Tube with solder fittings. Compression fittings can also be used. No threading is necessary with either type fitting. Wall thickness of tube used can thus be less than for threaded pipe.

NON-RUSTING

Rustable pipe eventually clogs as shown in drawing at top right. Non-rustable Revere Copper Water Tube suffers no loss of flow or pressure as shown at bottom right. No allowance in pipe size need be made for rust accumulation with Revere Copper Water Tube.

NEWS OF THE MONTH

CONVENTION COOLING SYSTEM

successful in spite of heated arguments and aggressive demonstrators.

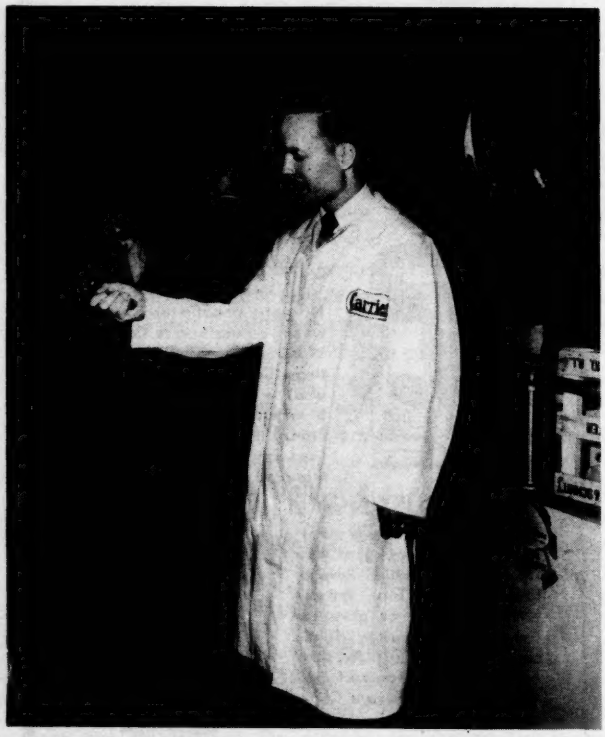
A flawless performance by the air conditioning system at the hottest Republican convention in years has scored for designers and manufacturers of the system and for the entire air conditioning industry, it is reported.

Although outside temperatures soared to a record 98.5F during the convention's opening day (July 7), and although the arguments among delegates were more torrid than had been expected, the Carrier system kept temperatures in the Chicago Convention Hall well below the design level of 80F.

Highest temperature recorded in the hall was 78F during the record heat of opening Monday afternoon. Temperatures never again topped 77F and most of the time were in the range of 72 to 76F.

Cloud Wampler, president of Carrier, said he was also sure after this first "coats-on" convention in history that political parties would never again return to the old sweat-soaked, shirt-sleeve conventions, like the Philadelphia hotbox conventions of four years ago.

• **SUPERVISION.**—Carrier maintained a full staff of specialists on duty to make sure the system functioned perfectly at all times. Carrier engineers armed with sling psychrometers were constantly patrolling the arena where delegates and spectators sat to check on temperatures and humidities.



Engineer spot checks convention hall wet bulb with sling psychrometer.

The engineers reported no variations of more than a degree between one part of the arena and another, even though there had been no chance beforehand to test the system with this large a human heat load.

Hourly records of temperatures inside and outside the hall were distributed twice a day to press, radio, and television to make sure that the information they released was accurate.

• **LOAD.**—The two big Carrier centrifugal machines, totalling together a thousand tons of capacity, reached full load only once. This was during the opening afternoon when the first big debate over seating of delegates reached the floor. The purring centrifugals came near full load only once after that, during General MacArthur's keynote speech Monday night, when they were putting out cooling at the rate of 985 tons a day.

• **THREAT.**—Only once was the operation of the system threatened—on Thursday night when demonstrators outside the Amphitheatre tried to break through the door of the equipment room to get inside the hall. Police and a stout wooden bar across the door ended the threat.

• **AUXILIARIES.**—Carrier not only kept the arena cool and comfortable with its big system, but also air conditioned the personal headquarters of General Dwight D. Eisenhower and Senator Robert A. Taft, the radio and television studios of the American Broadcasting Company, the Mutual Broadcasting System, and the National Broadcasting Company, and the Associated Press Wirephoto darkrooms. All of these installations were handled with Carrier self-contained Weathermakers and Carrier room air conditioners.

AUTO AIR COOLER

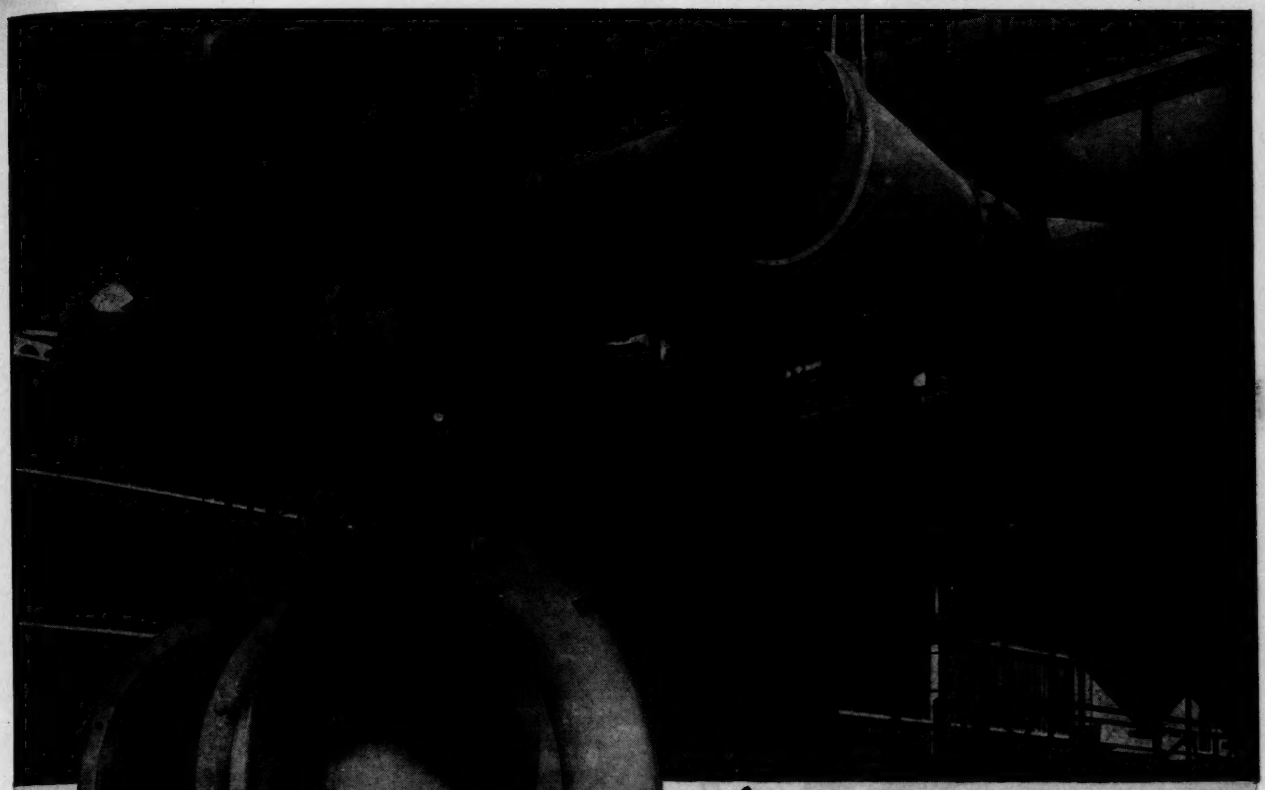
developed by General Motors will be optional in 1953 models. Quick air conditioning in hot sun is goal.

After several years of experimentation, development and testing, General Motors has perfected an air conditioning unit for automobiles, C. E. Wilson, president of General Motors, has announced.

• **TESTS.**—The unit is expected to be made available as optional equipment at added cost on the 1953 models of Cadillac and Oldsmobile. The air conditioners will be produced by the Frigidaire Division of General Motors. Prolonged tests of the unit have been made at the General Motors Proving Ground at Phoenix, Arizona, in southern Texas and elsewhere in areas of dry heat as well as in areas of high humidity.

Tests have shown that the heat inside a car that has been standing in the sun at high temperatures can be reduced to a comfortable driving temperature within a distance of six city blocks and that within a mile and a half driving distance, temperatures are very appreciably reduced. The new system provides adequate cooling even at low speeds.

(*Continued on page* 124)



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From every possible angle, JOY Series 1000 AXIVANE Fans will give you a better, lower-cost job. Their inline, vane-axial design is lighter and more compact; and they operate more quietly, require less power and space, and save greatly on installation time and costs. What's more, you get the extra flexibility of adjustable blades—a standard JOY feature—permitting easy and quick on-the-job regulation of pressure or volume over a wide operating range, with positive protection against motor over-load. ● Whatever your job is, JOY AXIVANE Fans can show you advantages—let us work with you.

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IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED · ONTARIO

AUTO AIR COOLER

(*Continued from page* 122)

• **DESIGN.**—The principal mechanism of the air conditioning unit will be located upon the shelf in the rear of the trunk compartment, without appreciably reducing the luggage space in the car. A single control will be placed on the dash of the car and temperature can be maintained at a desired level by setting a thermostat.

The air conditioning device will be particularly desirable not only in hot weather but also in dusty areas or under windy conditions because the car can be driven in any temperature with the windows closed. While the car will thus be automatically cooled, wind, noise and draft in the car are substantially reduced.

Engineering test drivers of cars equipped with the new cooling system report that they have driven in temperatures of 110 degrees in comfort. The test drivers actually found themselves vieing with one another for the privilege of driving the air-cooled cars and forecast a great demand for the new system.

The basic principal of the new system is the same as the cooling systems in offices and on railroad trains. A rotary compressor is mounted on the engine. A completely sealed refrigeration unit, using a non-toxic Freon is mounted on the shelf of the trunk. There is no appreciable difference in the exterior or interior appearance of the car equipped with the cooling system.

Mr. Wilson stated: Development of the system was a challenging engineering problem due to space limitation in the car and because quick cooling is so essential to satisfactory air conditioning in an automobile.

HEAT WAVES

make death rates soar. New York City study shows 77% rise in June spell.

The City of New York Department of Health, which has been conducting intensive studies in the last few summers on the relationship between protracted heat waves and death rates, released data early in July showing that fatalities rose sharply in the city during the hot spell at the end of June.

• **INCREASE.**—The statistics indicated that deaths reported to the Health Department increased 77% in those three sweltering days.

For the first twenty-four days of June, when the temperature was seasonal, the average number of deaths reported daily was 213. For June 25 through June 27, however, when the mercury zoomed upward and took New Yorkers by surprise, the daily fatality average was 376. There were 238 deaths listed on June 25, when the high for the day was 96.5 degrees; 430 deaths June 26 when the temperature went to 97, and 460 deaths the next day, when a high of 98 degrees was recorded.

• **IMPORTANT.**—"Statistics concerning the relationship between heat waves and death rates are important scientifically," a Health Department spokesman explained, "to determine precisely what the danger degree of heat is and what other factors, if any, are related, so that the public may be warned about the risk involved during such periods."

• **AGES.**—It has been found, according to the spokesman, that most persons who succumb during protracted heat waves are the very young, the very old and the chronically ill. It is important, therefore, that precautions be taken to keep those groups comfortable when the mercury stays up on successive days.

The study shows that the daily average number of deaths among persons 65 years old or older rose from 103 for the first twenty-four days of June to a daily average of 210 in the three-day heat wave.

The next largest increase in the death rate occurred in the 45 to 64 year old age group. Here, the daily average increased from seventy-six deaths for the first twenty-four days of June to a daily average of 123 for June 25, 26 and 27. A considerable death rate climb also was noted among infants under 1 year. The daily average for the first twenty-four days of the month for this group was eleven deaths as against a daily average of sixteen in the three-day hot spell. There were no death rate changes during the heat wave in the age category between 5 and 24.

• **PRIOR.**—The Health Department said that in the heat wave of August, 1948, when temperatures reached higher levels than in the recent hot spell and stayed at those levels for a longer period, the number of deaths tripled the usual average. Other heat waves severe enough to bring about a marked increase in the number of deaths occurred in 1925, when an unusual hot spell in the middle of June raised the death rate 60%, and in the summer of 1937 when a 45% death rate increase was reported.

I-B-R RESEARCH

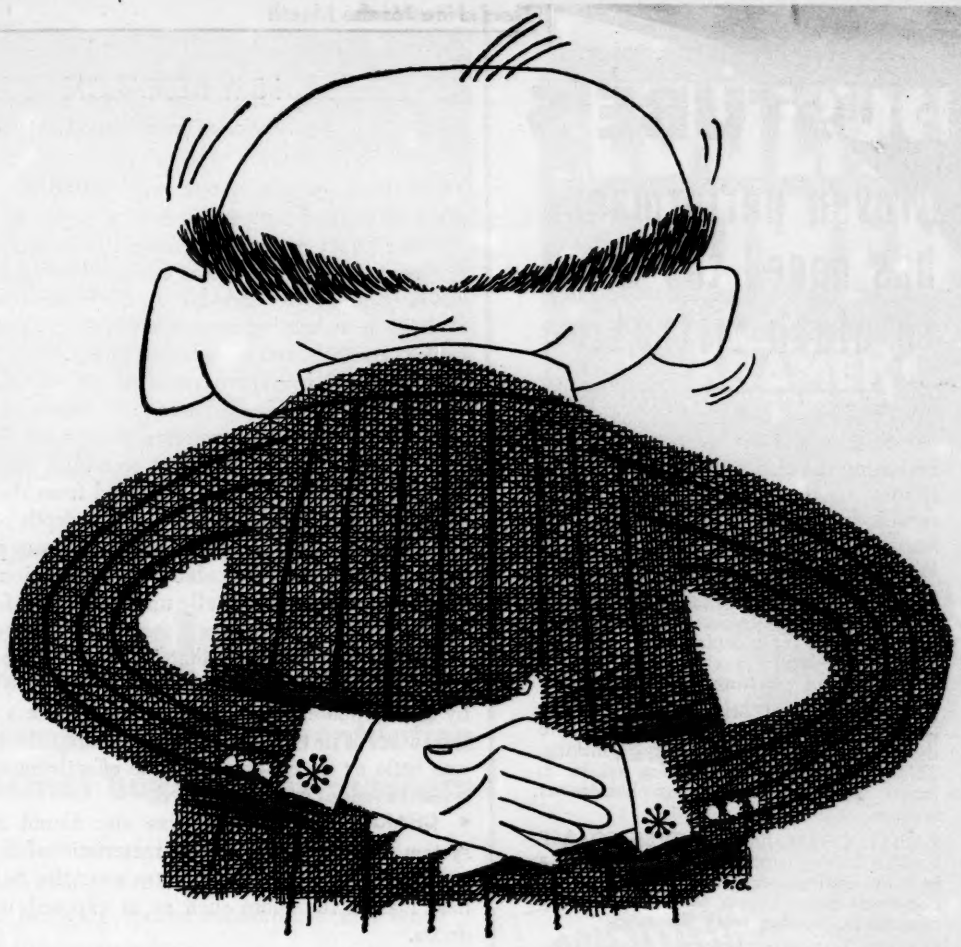
now in 12th year, will be continued by membership vote at 37th annual meeting.

Continuation of the I-B-R research program at the University of Illinois—now in its 12th year—was approved by members at the Institute's 37th annual meeting.

In reporting on the research program, Warren Harris, research professor at the University of Illinois, said that the I-B-R Research Program for the 1951-1952 heating season consisted of two major projects. First was an investigation on the performance of floor panel heating systems. Second was a study of the heating effect of radiators, convectors, and baseboards under actual use conditions.

• **PANEL HEATING.**—Professor Harris pointed out that the panel heating project was sponsored jointly by The Institute of Boiler and Radiator Manufacturers and the Engineering Experiment Station of the University of Illinois. In addition to supplying part of the staff, the University made available the floor-slab laboratory and all of the instruments required for the investigation. The floor-slab laboratory contains four test rooms. An elab-

(*Continued on page* 126)



Would you turn your back on a 4-for-1 saving?

MORE THAN 10,000 DOREX USERS are glad they didn't. They're the economy-wise buyers who, over the past twenty years, have made Dorex Air Recovery part of their air conditioning installations.

You see, Dorex Air Recovery "manufactures" *fresh* air by passing *used* air through the famous Dorex C Cell, with beds of specially activated carbon that remove all odorous and gaseous impurities. This means *only about one-third* as much new air need be taken into the system. Substantially less heating and cooling equipment is needed; operating costs are much lower.

Specifically, users' experience has shown that every $100 invested in Dorex Air Recovery should return a saving of $400 on initial air conditioning expense; and, over the years, every $1 spent for Dorex maintenance should produce a $4 saving in operating costs.

Find out how much this four-for-one return can add up to in your plant. Write us for full information.

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air recovery

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Please send me, without obligation, full information on Dorex Air Recovery.

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DUSTUBE'S

proven performance has paced the trend to cloth filtration

The simple, yet effective cloth tubular design of Dustube Collectors has proven so efficient and economical that it is becoming the standard by which all collectors are evaluated. Its dependable, trouble-free operation makes it a collector you can install with confidence. Here's why:

HIGH EFFICIENCY WITH NO VISIBLE DISCHARGE—Uniform recoveries approaching 100% are commonplace. It is the only method that insures a clean stack under a wide variety of operating conditions.

MORE EFFICIENT SHAKING — Shaking periods are shorter and less frequent due to the perfected, efficient method of shaking. This results in lower operating resistance, longer cloth life and direct horsepower savings.

BAFFLE CHAMBER REMOVES COARSE PARTICLES—To protect the cloth filters, a built-in impingement chamber deflects air downward into a hopper and removes coarse particles before they reach the tubes.

LOWER PRESSURE DROP—Dustube design gives minimum static pressure loss (less H.P. required) due to ample expansion areas on the clean and dirty air sides plus efficiency of the shaking device.

NO WATER SUPPLY OR SEWAGE PROBLEMS—Material is recovered in a dry, free-flowing state without dewatering, filtering or drying. No water is used in the collection process and there are no sludge ponds or wet disposal problems.

Send for your copy of Catalog No. 372.

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WHEELABRATOR & EQUIPMENT CORP.
619 S. Byrkit St., Mishawaka 4, Ind.

dustube COLLECTORS

I-B-R RESEARCH

(*Continued from page* 124)

orate thermocouple system was provided for measurement of ground temperatures to a depth of twenty feet.

Floor panel heating was installed in each of the four test rooms. Each panel was designed in accordance with I-B-R Installation Guide No. 6. Each panel was provided with its own heating system consisting of coils, electric heater, controls and circulating pump.

• **INSULATION.**—Three methods of applying floor insulation were used. In room "A" the edge and entire under surface of the concrete floor were insulated. In room "B" the insulation was placed along the inside edge of the foundation wall and extended from the top surface of the concrete slab floor down to a depth of 18 inches. In the other two rooms the insulation was placed vertically between the floor slab and foundation on the exposed walls and horizontally under the floor for a distance of two feet.

The University found that insulating the entire underside of the slab reduced the heat flow into the ground by approximately three per cent and made a corresponding increase in the rate of heat flow into the room. There was little or no difference in the effectiveness of the two types of edge insulation used.

• **CHARACTERISTICS.**—It was also found that a panel system has the desirable characteristic of automatically increasing the heat output rates near the points of high heat loss of the room such as at exposed windows and doors.

The total temperature difference from the floor to the ceiling in a panel-heated room was less than one degree Fahrenheit in the rooms studied. The temperature of the exposed north wall was found to be approximately the same as the room air temperature. The other walls were some three to five degrees Fahrenheit warmer than the room air.

As originally set up, the investigation of heating effect was to run for two years and representative radiators, convectors and baseboards were to be included in the tests.

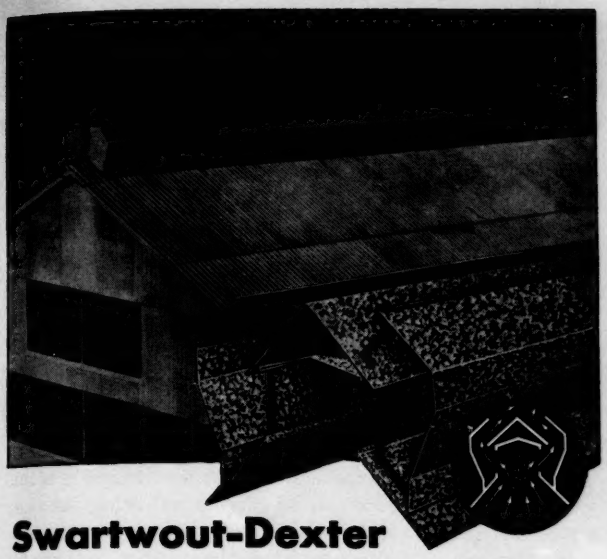
All units were to be tested in the Research Home while operating under usage conditions in connection with a forced circulation hot water system designed for a maximum operating temperature of 215F. To date tests have been completed on three of the 6 units to be included in the complete program.

• **HEATING EFFECT.**—While the program is only half completed, said Professor Harris, the results we have obtained thus far seem to demonstrate that heating effect is more a function of the way the equipment is used than it is a function of the design of the equipment. This being the case it would not seem that heating effect allowances should not be made to catalogued output ratings of a particular piece of equipment.

By continuing this program through the next heating season, we should obtain information necessary to show whether or not heating effect allowances are justified for actual usage conditions, Professor Harris declared.

• **ASHVE RESEARCH.**—A report on the panel heating

(*Continued on page* 128)



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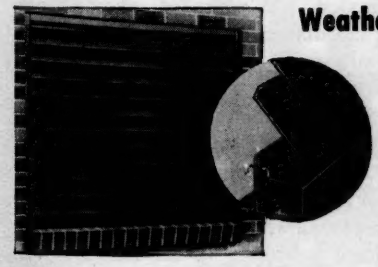
Heat Valve® Roof Ventilator

brings simple, practical ventilation to industrial buildings everywhere

"Heat Valve" as originated by Swartwout and installed throughout industry on almost every type of building means economical, efficient *natural flow* ventilation.

As a continuous opening it is particularly popular for ridge ventilation on peak roofs or for sawtooth construction. But it is equally efficient in shorter sections, on flat or slope roofs or on skylights.

Heat Valve design features short air travel with minimum friction; compact design; effective adjustable damper control. It supplies large air-moving capacity per square foot of opening — at economical cost. Completely weatherproof. Made in 10 standard throat sizes. Write for Folder 336F.



Weatherproof Louvers

Swartwout Airlouvers are custom-made for each job *without premium cost*. Adjustable and fixed styles available in wide range of sizes. Overlapping blades, sturdy channel frame.

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Roof Ventilators and Ventilating Louvers

POWER PLANT EQUIPMENT • PROCESS INDUSTRY CONTROLS

COOLING TOWER

by KRAMER

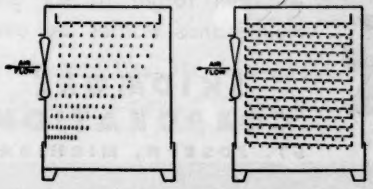
3 to 8 Ton

SCIENTIFIC NEW FILL

MORE CAPACITY
The redistributing decks keep the water uniformly suspended, providing maximum contact between air and water.

LONG LIFE
Casing and sump are heavy gauge steel, hot dipped galvanized after fabrication. Redistributing decks are metal and fireproof.

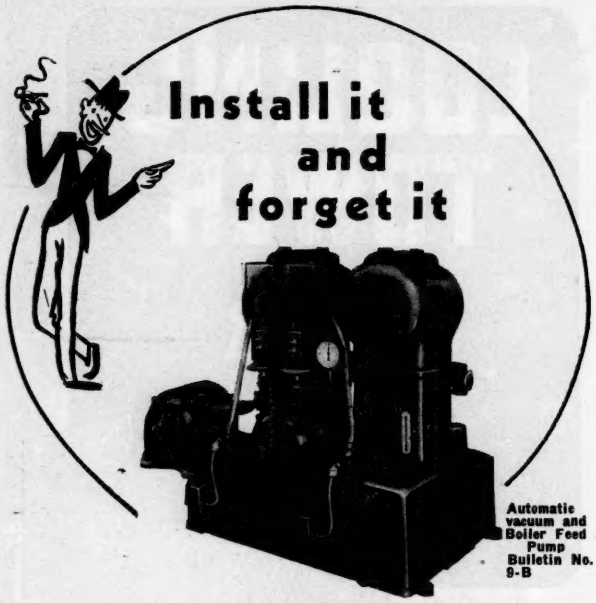
EASY INSTALLATION
Unit is shipped assembled but can be knocked down to eliminate rigging costs. One fitting required for drain and over-flow.



Conventional Fill Kramer Fill

Write for Catalog R-225

KRAMER TRENTON CO.
Trenton 5, N.J.



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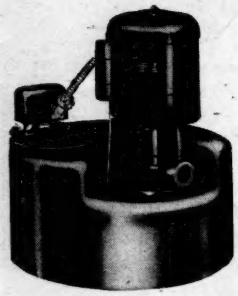
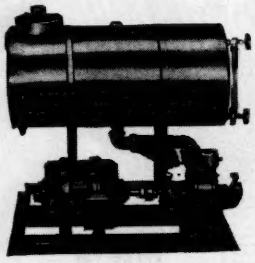
Skidmore Pump

Consider the Skidmore Automatic Vacuum and Boiler Feed Pump — it adjusts itself automatically to varying conditions of the systems — capacity remains constant year after year, without adjustments or expensive repairs — operates quietly, economically and dependably under all normal conditions.



Type CV—Bulletin No. 21



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MINIMUM OPERATING PARTS

The Skidmore Pump is designed with minimum operating parts —easily accessible without disturbing piping connections. Constructed with bronze impeler. Switches and motors are of proper capacity. Yes, once you install a Skidmore Pump you can forget it! for your maintenance worries are over.

SKIDMORE CORPORATION
ST. JOSEPH, MICHIGAN

There's a wide range of sizes and capacities for every heating pump need. Sales representatives in principal cities.

SKIDMORE PUMPS

I-B-R RESEARCH

(*Continued from page* 126)

research program of the American Society of Heating and Ventilating Engineers was made by Peter B. Gordon of Wolff & Munier, Inc., New York City. Mr. Gordon is chairman of the technical advisory committee on panel heating and cooling of the ASHVE.

Mr. Gordon pointed out that there is no duplication of effect between the panel heating research program at the University of Illinois and the panel heating research program carried on by the ASHVE.

The significance of the Environment Research Laboratory of the Society in Cleveland was emphasized by Mr. Gordon. Careful measurements of the heat transfer from warm surfaces to space can be carried out at the laboratory, Mr. Gordon said.

Studies are also proposed on the relation of panel heating to comfort. Studies of the relation of various control systems to panel heating are being carried out.

• **SHORT COURSE.**—An advanced short course in hot water and steam heating will be given at the University of Illinois, Urbana, Illinois, September 9, 10, and 11. The emphasis in the short course will be on the application of the methods taught in the I-B-R installation guides to the design and installation of hot water and steam heating systems in small commercial and industrial buildings.

TURBULENCE

analyzed by electronic computer in project telescoping 1,000 years of calculation to 150 hours.

Columbia University has announced the solution of a basic problem that has confronted scientists for more than sixty years and could not have been solved by any human mathematician.

• **FAST.**—The correct answer was finally found by the International Business Machines' giant electronic "brain" at 590 Madison Avenue, New York, known as the selective sequence electronic calculator. The machine's 12,500 vacuum tubes performed some 20,000,000 calculations in a total working time of 150 hours, telescoping in that time interval an estimated 100 years of computations with the aid of a desk calculator, or more 1,000 years of figuring with paper and pencil.

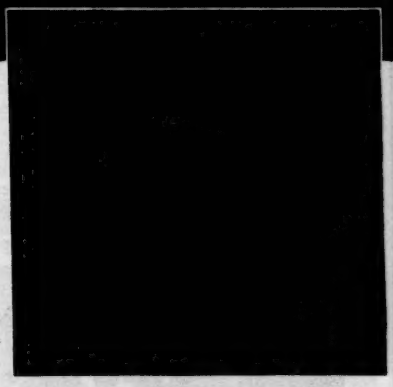
• **FLUID MOTION.**—The solution is expected to lead to a better understanding of the principles governing fluids in motion (hydrodynamics), which, in turn, could lead to the design of better aircraft, steam turbines, hydroelectric power generating machinery and possibly more efficient atomic power plants. It may also pave the way to the solution of related problems in the study of the complicated phenomena of turbulence, which, according to modern theories, played an important role in the origin of the universe.

Announcement of the latest achievement of the robot "mathematician," which can give answers only when

(*Continued on page* 130)

This modern plant is heated with modern REVOLVING Unit Heaters

The Crawfordsville, Indiana plant of Raybestos-Manhattan, Inc., one of the country's leading manufacturers of asbestos and rubber products is an example of a modern carefully planned industrial building, laid out for highest efficiency in manufacturing. Typical of the equipment selected with this end in view are the Wing Revolving Unit Heaters. These heaters, by distributing the heated air downwards in a constantly changing direction, keep the workers comfortably warm and invigorated, without subjecting them to constant blasts of hot air or chilly drafts. Wing Revolving Unit Heaters are worth a great deal from the standpoint of employee relations alone.



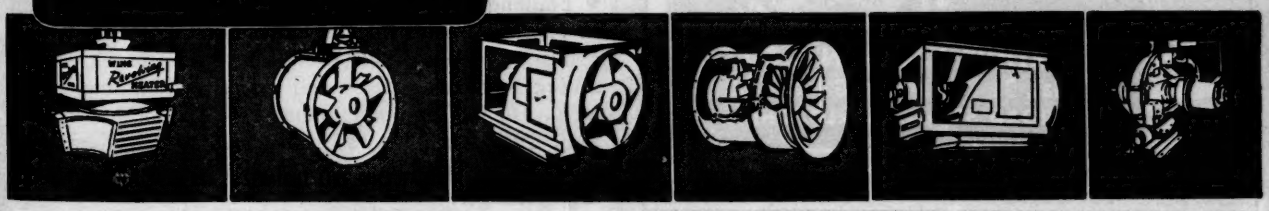
The discharge outlets of the Wing Revolving Unit Heaters revolve slowly, distributing the heated air downwards in gently moving streams, that can be adjusted for different shapes of areas to be covered. In the summer time, with the heat turned off they act as a perfect air cooling system.

Wing

REVOLVING UNIT HEATERS

L. J. Wing Mfg. Co. 158 Vreeland Mills Road, Linden, N.J.

Factories, Linden, N.J. and Montreal, Canada
In Europe: Establissements WANSON, Haren-Nord, Brussels, Belgium



LOOKING FOR SOMETHING?

Anyone looking for parts, to repair or service a heater is well off if the parts are standard products of nationally known manufacturers.

All accessories on Olson heaters are of the best name and quality known to heating engineers. Replacement of these parts are always easily available anywhere.

Olson unit or central warm air heaters are manufactured by heating engineers with the "know how" gained from many years of experience in the heating industry.

Olson

ARTHUR A. OLSON & CO.
Gas, Oil, Coal or Dual Gas and Oil
BROAD ST. · CANFIELD, OHIO

Write for complete information and data sheet, showing horizontal and inverted models, stoker fired and duct units.

TURBULENCE

(*Continued from page* 128)

there is a human brain to think up the proper questions, was made by Prof. Wallace J. Eckert, director of the Watson Scientific Computing Laboratory at Columbia. The work was done under the direction of Dr. L. H. Thomas, professor of physics on the staff of the laboratory, which uses the giant calculator at the I. B. M. offices.

• **SPECULATION.**—Briefly, the machine has finally settled a theoretical controversy begun in 1888, when the British scientist, William Thomson Kelvin, started speculation on the origin of turbulence in a stream of fluid flowing at uniform speed between two parallel plates. A hypothetical example of this situation, Dr. Thomas explained, would be a curtain of water falling between parallel sheets of glass at constant speed.

Lord Kelvin, and many present-day authorities in the field of hydrodynamics, believed that some finite, outside disturbance would have to be introduced into such a stream to break up its regular motion. The electronic robot, proved, however, that the great Lord Kelvin and his followers were wrong. It established the fact, Professor Thomas reported, that "fluids of low viscosity, when moving rapidly, become unstable without any outside influence.

COOLING EQUIPMENT

for air conditioning and refrigeration in 1951 shows 8% gain over 1950, Census Bureau says.

Shipments of components and accessories for air conditioning and commercial refrigeration equipment in 1951 were valued at $213 million, up 8% over 1950, according to the Bureau of the Census, Department of Commerce. Shipments of condensing units in 1951 totaled 840 thousand, valued at $76 million, representing no decline in value from the previous year but a drop of 46 thousand in number of units. A total of 1,052,000 compressors and compressor units, valued at $57 million, were shipped in 1951. This represents increases of 10% in number of units and 21% in value compared with 1950. The value of heat-exchanger equipment shipped in 1951 amounted to $65 million, an increase of 6% over the previous year, and shipments of centrifugal refrigeration systems, at $15.3 million, showed a 25% gain over 1950.

• **UNITARY EQUIPMENT.**—Shipments of self-contained air-conditioning units totaled 282,488 valued at $94 million in 1951, up 10% and 8% respectively, over number of units and value in 1950.

• Edmund T. Flanagan has been elected vice president in charge of sales for the Fairbanks Co. Mr. Flanagan brings to his new post over thirty years of experience selling Fairbanks valves and materials handling equipment. He was assistant manager of the Boston branch until 1947 when he was transferred to the New York office as manager and later as New York and regional sales manager.

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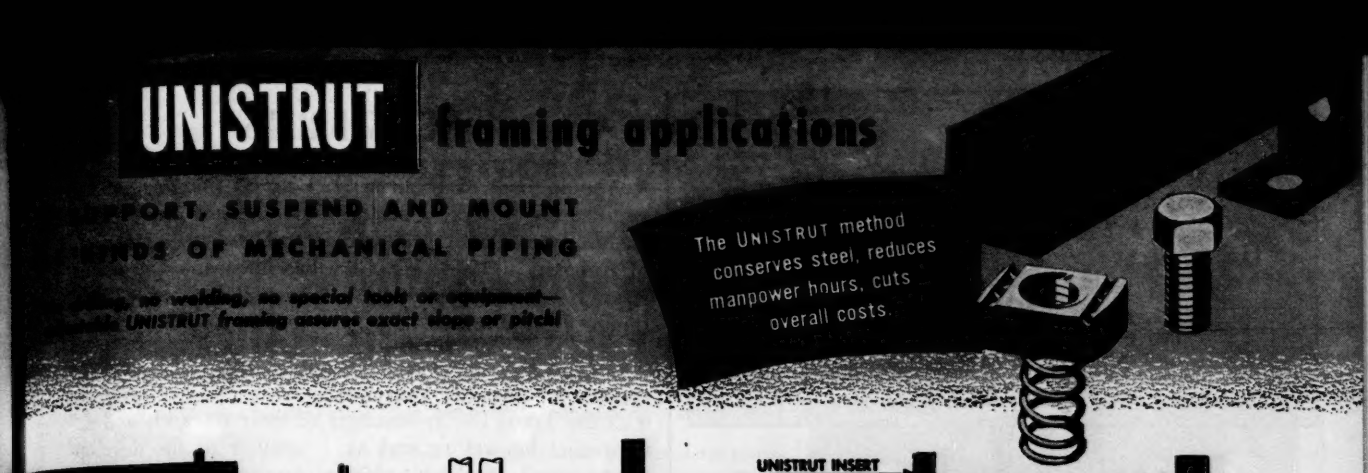
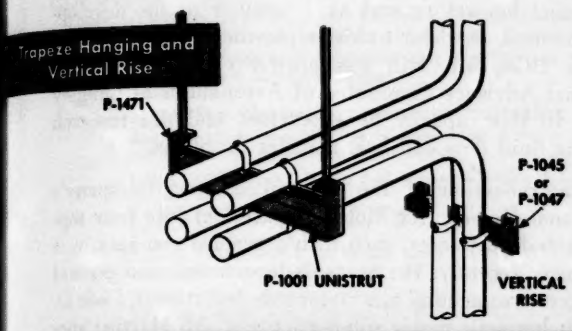
...no welding, no special tools or equipment— ... UNISTRUT framing assures exact slope or pitch!

The UNISTRUT method conserves steel, reduces manpower hours, cuts overall costs.

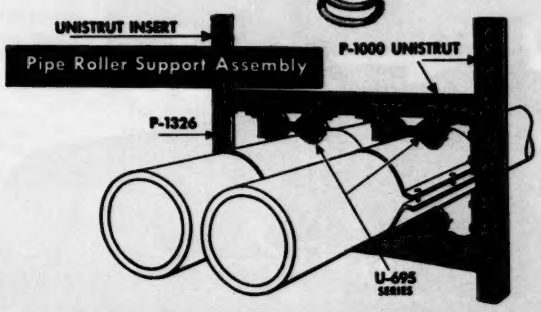


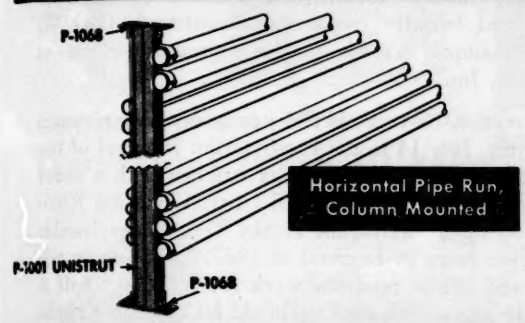
Trapeze Hanging and Vertical Rise



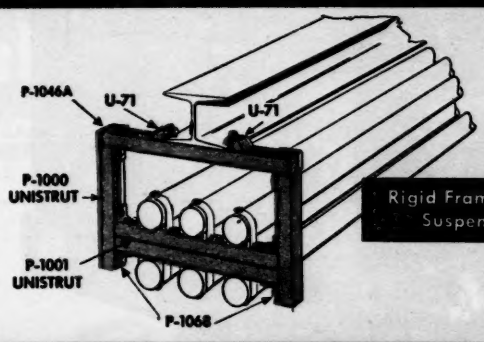
UNISTRUT INSERT

Pipe Roller Support Assembly



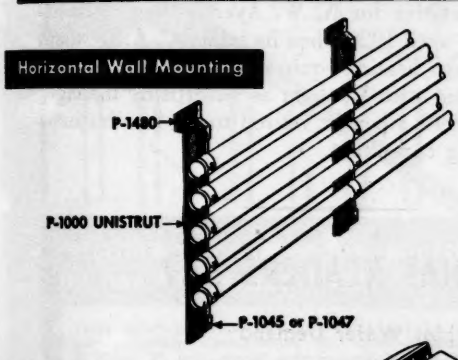


Horizontal Pipe Run, Column Mounted

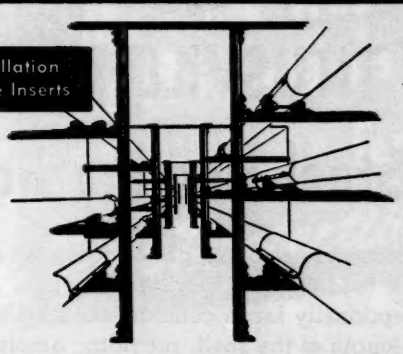


Rigid Frame Beam Suspension

Horizontal Wall Mounting



Tunnel Installation with Concrete Inserts



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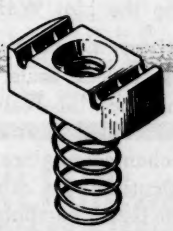
offers this Spring-Held Clamping Nut which ties together both sides of the slotted channel and forms a *Box Section* at points of connection for greater load strength.



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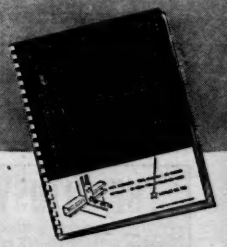
of New 78-page Catalog No. 7001 includes above drawings and countless other examples of how to mount, rack, frame, suspend and support all kinds of mechanical and electrical equipment.



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Company_____

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FOR ALL FUELS

AND ALL TYPES OF FIRING

The **TITUSVILLE** *"Compact"*

Steel Heating Boiler

Economical use of oil, gas or coal is an outstanding advantage of the Titusville "Compact" Boiler. An exceptionally large combustion chamber runs the full length of the shell, providing ample space and time for complete burning—yet the boiler takes up less room than any other type. ● Extensive automatic welding of seams and joints, positive circulation, steel flue-door assemblies and other refinements assure trouble-free service.

Write for Bulletin B-3000-B.

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TITUSVILLE, PENNSYLVANIA

NEWS BRIEFS

● Appointment of Richard H. Clay as manager of the engineering service department has been announced by A. M. Byers Co. A graduate in mechanical engineering of Auburn, in 1948, Mr. Clay has been associated with Byers for the past two years. Previously he was with the Ingalls Iron Works.

● E. John Hill has joined Kennard Corp. of St. Louis as director of research and development. He was formerly with the Trane Co. as manager of their research and development laboratory and as a member of the development committee. Prior to his employment with the Trane Co. in 1946, Mr. Hill was project engineer with the National Advisory Committee of Aeronautics at Langley Field. In this capacity he supervised and did research work in fluid flow and heat transfer problems.

● Decentralization of the General Electric Company's Fractional Horsepower Motor Department into four separate sub-departments, each with a general manager, was announced recently. The new sub-departments and general managers are: general a.c. motor sub-department, Lisle D. Hodell; hermetic motor sub-department, Ab Martin; specialty motor sub-department, Jack J. Clarkson; and electric sink and laundry motor sub-department, Carl W. Moeller. Headquarters for all four groups will be at Fort Wayne, Ind.

● O. J. Prentice, 85-year-old Chicago advertising pioneer, died Monday, July 14 in the Presbyterian Hospital of the City of Chicago. Mr. Prentice was stricken with a heart attack while attending a National District Heating Association meeting in early June at Sky Top, Pennsylvania. Mr. Prentice, born in England in 1867, had been in advertising and public relations work for well over half a century. He was with Long-Critchfield & Co. (now Critchfield & Co. at Chicago) from 1894 to 1907. He was western representative for N. W. Ayer & Son, Philadelphia, from 1907 until 1920 when he joined C. A. Dunham Company, Chicago heating equipment manufacturer. Mr. Prentice remained with Dunham as advertising manager until Dec. 31, 1949, when he retired to go into business as an advertising consultant.

WHAT READERS SAY

Computing the Hot Water Demand

EDITOR, HEATING AND VENTILATING

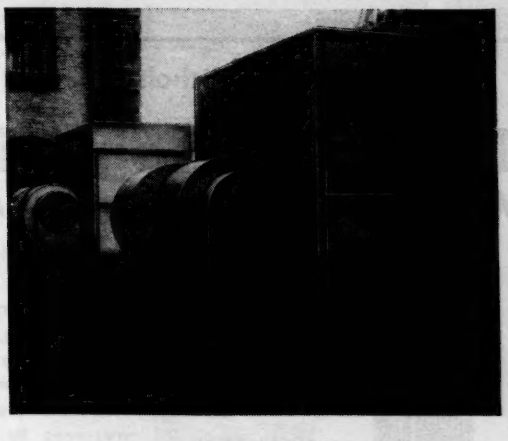
In the July, 1952 issue, on page 70 you have an article, Computing the Hot Water Demand for the Washroom Facilities Installed in an Industrial Plant, by Howard S. Molk, mechanical engineer.

Our attention was attracted to the third paragraph wherein he lists a computation labeled "L" which he used to indicate as a symbol for the number of basins. He further states that in the case of a wash fountain, use an equivalent number of basins. Later on in the article, it is stated for an ordinary basin a flow of 3 gpm should be used.

As an example a 54-inch diameter circular wash foun-

(*Concluded on page* 134)

where conditions demand QUIET water cooling use Binks Blower-Type Towers



With no more noise than that made by a good domestic refrigerator, Binks Blower-Type Cooling Towers provide circulating water for air conditioning compressors up to 60 tons capacity.

That's why Binks Type 2-B and 2-BB Towers are just what you need for refrigeration and air conditioning systems in hospitals, hotels, private homes, apartment buildings, business establishments and other places where excessive operating noise simply will not be tolerated.

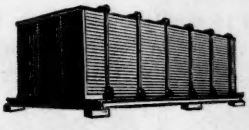
Send for these informative bulletins
describing Binks complete line of mechanical draft cooling towers. No obligation, of course:

Bulletin 47-A—Types 2-B and 2-BB (capacity ranges, 3 to 60 tons of refrigeration)
Bulletin 33—Type 2-D (1 to 30 tons)
Bulletin 34—Type 2-D, twin fan (50 to 100 tons)
Bulletin 35-A—Type B (3 to 21 tons)
Bulletin 36—Type 2K-S (50 to 220 tons)
Bulletin 39—Type K (333 to 1000 tons)

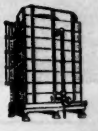
Write to: Binks Manufacturing Company
3120-38 Carroll Ave., Chicago 12, Ill.

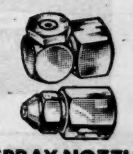
For moving large volumes of air *quietly*, the squirrel cage blowers in Binks Type 2-B and Type 2-BB towers are unsurpassed. By using a multi-bladed rotor at slower speeds, these efficient units insure adequate air movement without the noises that characterize other methods of forced draft cooling.

The picture above of Type 2-BB towers on the roof of a commercial building evidences their suitability where quiet operation is essential.



Binks





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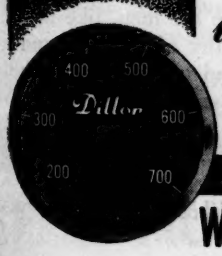
These carefully engineered instruments can be screwed into tanks, boilers, kettles, stacks, pipes, etc. Come in *standard* stem lengths of 5" or 9" with special *intermediate* lengths up to 80". Dials are 1", 2½", 3" or 5" dia. as desired. Made of acid-resisting stainless steel. Numerous ranges from as low as 0-200° F. up to 200-1000° F. Also available in Centigrade ranges. DILLON engineers will be glad to adapt this unit to *your* product if you are an O.E.M. Thousands in use. Write for illustrated brochure and prices.



the **DILLON** *dial*
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thermometer

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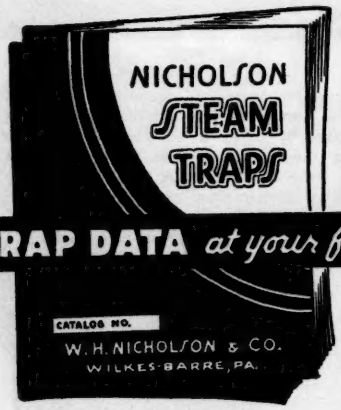
Newly revised, this 32-page reference describes traps for all mediums and pressures: thermostatic and metal expansion for pressures to 250 lbs.; weight and piston - operated for heavy duty. Complete with installation diagrams and formulae for determining proper size trap.



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- Motor out of line of air flow — for better performance in moisture filled air.

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WRITE TODAY FOR COMPLETE INFORMATION

MANUFACTURING CO. OWATONNA 3, MINN.

(*Concluded from page* 132)

tain will accommodate 8 to 10 persons, or in other words it replaces 8 to 10 individual basins. Following the instructions outlined, an allowance of 24 to 30 gpm would be necessary in the calculation for a fixture of this sort. The actual flow from the circular spray head of the circular fountain is 7 to 9 gpm or roughly one-third of the amount indicated to be used in the calculation.

We are wondering if this is an oversight, or whether the author of the article has been misquoted.

One of the reasons for the use of the circular wash fountain is to reduce the consumption of hot water over that required by the same number of individual fixtures which it replaces. On a sizable installation, this calculation could be quite important.

We believe that the subject of Mr. Molk's article is one that holds a great deal of interest for many of your readers and is a subject that is quite controversial and one that causes management many a headache.

M. M. Rivard
Rivard Sales Co.

Kansas City, Mo.

This letter was directed to the attention of Mr. Molk and his reply follows:

I was very glad to read the comments of M. M. Rivard concerning the calculation for the wash fountain in my recent article, Computing Hot Water Demand. Mr. Rivard has brought up a point which I had overlooked in my calculations.

In order to obtain the time interval of continuous usage of the various fixtures, it is necessary to substitute for each wash fountain an equivalent number of basins based upon the number of people accommodated by the wash fountain. Up to this point in my calculations and examples I believe I am entirely correct. However, for the calculations of the actual hot water required, I should have set up the basins and the wash fountain individually and then multiplied by the respective rates of flow. Thus, in the solution of my sample problem, the total hot water required should have been calculated as follows:

Shower heads	= 3 x 30 x 3½	= 315 gal
Basins	= 3 x 24 x 2	= 144 gal
Wash fountains	= 1 x 24 x 2	= 48 gal
	Total	= 507 gal

As a guide for the wash fountain calculations, the following chart may be used. The writer suggests that the manufacturer be consulted for the exact data concerning any particular wash fountain.

Type	Size, Inches	No. of People Accommodated	Approx. Hot Water Consumption, GPM
Semi-Circular	36	3	2
	54	5-6	3
Circular	36	5-6	3
	54	8-10	5

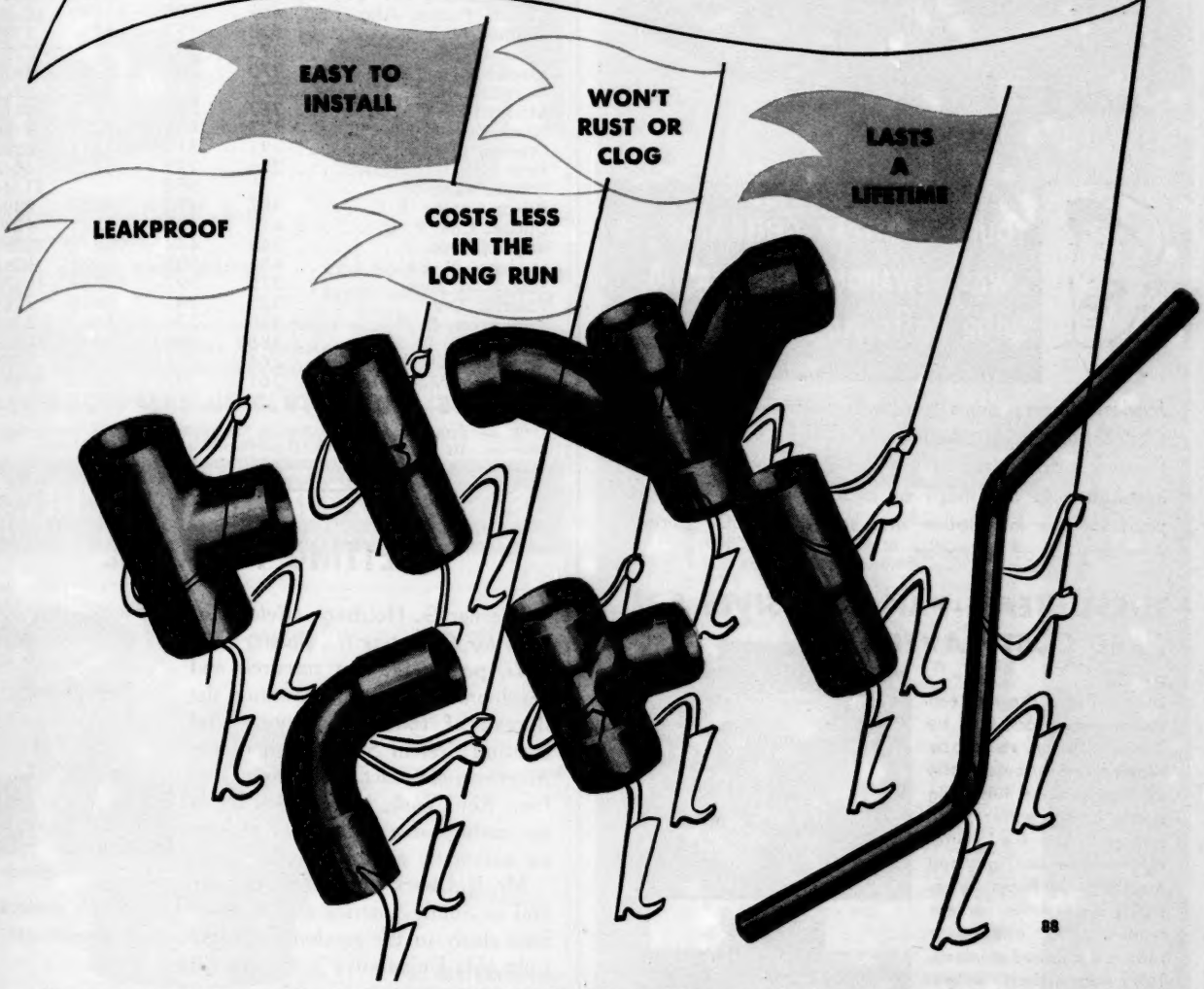
It is gratifying to realize that there are men, like myself, who feel that this subject is worthy of the time and effort necessary to exchange ideas and criticisms, which will eventually result in a clear, concise understanding of the problems involved.

Howard S. Molk
Mechanical Designer
Gibbs & Hill, Inc.

New York, N. Y.

You can use copper for plumbing . . . so why not use the best . . .

Streamline® COPPER TUBE AND SOLDER TYPE FITTINGS



Yes, you *can* use copper for both domestic hot and cold water lines and underground service lines. So, when you give your customers copper, install the best . . . STREAMLINE copper tube and solder type fittings.

Here's why it pays to use STREAMLINE copper tube and solder type fittings:

- They save installation time and money because both tube and fittings are precision machined for perfect fit.
- Uniform solder cup depths simplify roughing-in.
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- It's permanent—can't rust, won't clog and lasts more than a lifetime.

Architects, Plumbers, Builders and Home-owners all agree on the permanence, the economy and the common sense of an all-copper plumbing system.

IT PAYS TO USE COPPER FOR PLUMBING AND HEATING . . . WHY NOT USE THE BEST—STREAMLINE COPPER TUBE AND SOLDER TYPE FITTINGS.

STREAMLINE copper tube is available in 20 ft. straight lengths and 60 ft. coils. See your jobber for further information or write today for catalog S-352 and details concerning present government regulations on the use of copper.

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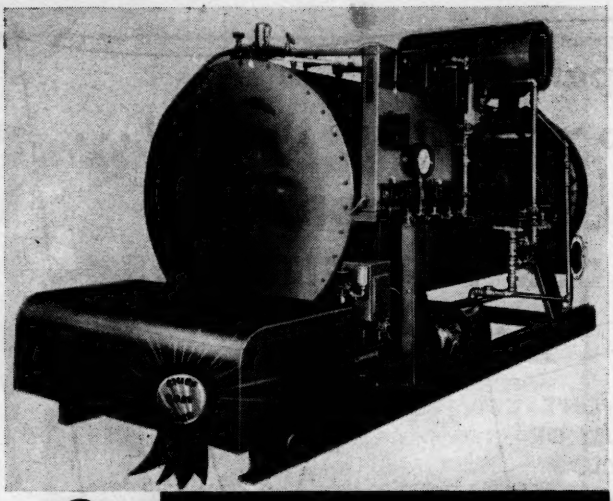

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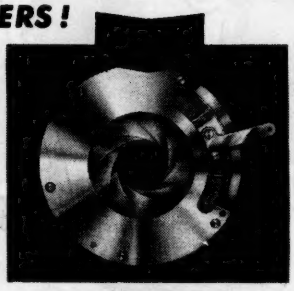

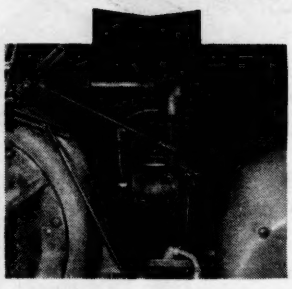

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Canadian Degree-Days for May, 1952*

City	May		Cumulative Sept. 1 to May 31	
	1952	Normal	Normal	1951-52
Calgary, Alta.	458	480	10047	9111
Charlottetown, P. E. I.	583	536	8001	8263
Crescent Valley, B. C.	372	403	7752	7731
Edmonton, Alta.	335	428	10524	9797
Fort William, Ont.	502	567	10166	10045
Grande Prairie, Alta.	409	505	11192	10122
Halifax, N. S.	533	493	6808	7395
London, Ont.	372	307	7259	7275
Medicine Hat, Alta.	270	301	9261	8495
Moncton, N. B.	571	474	8252	8568
Montreal, P. Q.	367	325	7949	8413
North Bay, Ont.	477	434	9487	9180
Ottawa, Ont.	391	310	8314	8674
Penticton, B. C.	285	273	6725	6346
Porquis Junction		558		11144
Prince George, B. C.	487	490	9852	8996
Quebec City, P. Q.	412	428	8501	9276
Regina, Sask.	368	434	10982	10891
St. John, N. B.	484	505	7421	8081
Saskatoon, Sask.	375	397	11367	10478
Toronto, Ont.	325	341	6615	7236
Vancouver, B. C.	339	326	5509	5303
Victoria, B. C.	386	366	5299	4935
Windsor, Ont.	264	251	6473	6705
Winnipeg, Man.	361	397	10313	10841

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

GETTING PERSONAL

W. G. Holzbock

Werner G. Holzbock (*Relay Circuits for Operating Oil Burner Controls*, page 71) is a research and development engineer heading the Bureau of Industrial Process and Heating System Supervision of the American District Telegraph Co., Inc., New York, since 1948. He is the author of a number of articles on automatic control.

Mr. Holzbock studied in Germany and in South America and is now carrying on postgraduate study in the mechanical engineering department of Columbia University, New York City.

C. E. Lund

C. E. Lund (*Condensation Control in Buildings*, page 80) is professor and assistant director, Engineering Experiment Station, University of Minnesota. He is a graduate of the University of Minnesota with Bachelor of Mechanical Engineering and Master of Science in Mechanical Engineering degrees. Following graduation he was appointed heating, ventilating and air conditioning inspector, City of Minneapolis. Except for three years as director of research for Seeger Refrigerator Co., he has been associated with the Uni-

(*Concluded on page* 138)

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Housing Sides—Cutoff Plate and scroll Sheet.

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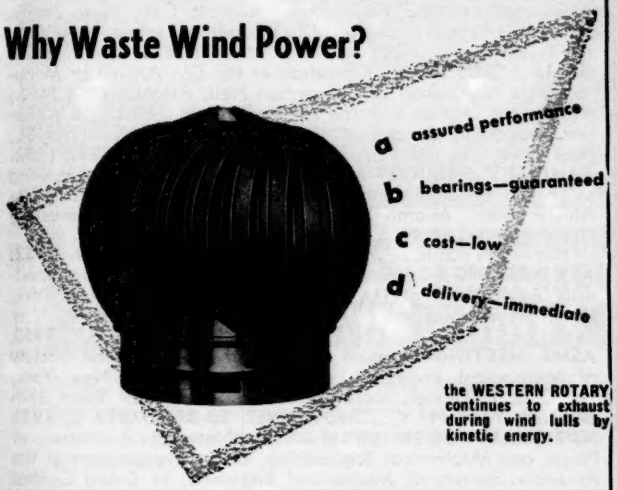

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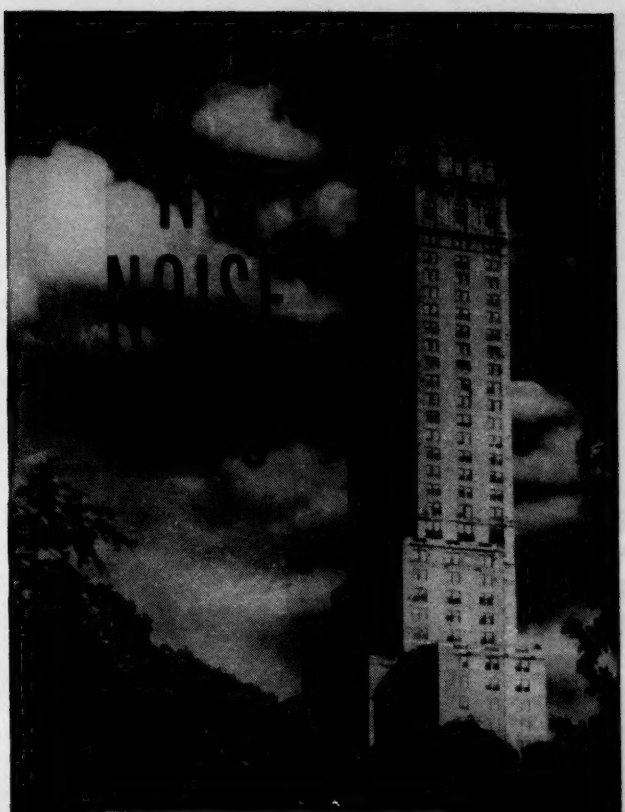

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Cooling tower noise can mean loss of rental revenue, tenant dissatisfaction, bad public relations and, in extreme cases, injunctions which mean shutting down the system. Specifying noise suppression as part of the original installation generally saves money and headaches in the long run.

Specify ISC's "Soundmetal" panels, because every ISC installation is individually engineered to the specific noise problem . . . and because ISC, the pioneer in industrial noise control, has the experience and the engineering skill to assure your complete satisfaction.

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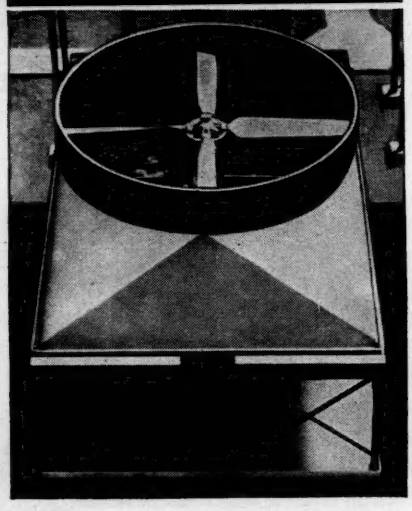

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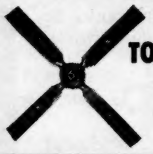

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Name

Title

Company

City Zone State

(*Concluded from page* 136)

versity of Minnesota, Engineering Experiment Station, for the past 14 years in the following capacities: Research engineer, assistant professor and assistant director, Engineering Experiment Station; associate professor and assistant head, Mechanical Engineering Department; and professor and assistant director, Engineering Experiment Station. He is author and co-author of over 50 publications on vapor transmission, condensation, insulation, refrigeration, heating, air conditioning, and related subjects. He was recipient of the Wolverine Award in 1946 and a national "Outstanding Publication Award" from the American Society of Refrigerating Engineers.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

ASME MEETING—Fall meeting of the American Society of Mechanical Engineers, at the Sheraton Hotel, Chicago, Ill. C. E. Davies, secretary of the Society, 29 West 39th St., New York, N. Y. ..... **SEPTEMBER 8-11, 1952.**

INSTRUMENT CONFERENCE AND EXHIBIT—Seventh National Instrument conference and exhibit, in Cleveland, Ohio. John McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 33, Pa. ..... **SEPTEMBER 8-12, 1952.**

NACE MEETING — South Central Region's meeting of the National Association of Corrosion Engineers, in New Orleans, La. Secretary of the Association, 1061 M & M Building, Houston 2, Texas ..... **OCTOBER 1-3, 1952.**

WELDING MEETING—Annual meeting of the American Welding Society at the Bellevue-Stratford Hotel, Philadelphia, Pa. I. G. McGrath, secretary of the Society, 33 W. 39th St., New York 18, N. Y. ..... **OCTOBER 19-24, 1952**

AGA CONVENTION—Annual convention of the American Gas Association, in the Auditorium, Atlantic City, New Jersey. Secretary of the Association, 420 Lexington Avenue, New York, N. Y. ..... **OCTOBER 27-30, 1952.**

GAMA EXPOSITION—Exposition of the Gas Appliance Manufacturers Association at Convention Hall, Atlantic City, N. J., held in conjunction with the AGA convention. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. ..... **OCTOBER 27-31, 1952.**

SANITARY ENGINEERING MEETING—46th annual meeting of the American Society of Sanitary Engineering, at the McAllister Hotel, Miami, Fla. Herbert Schalber, annual meeting city chairman, 46 N. E. 6th St., Miami, Fla. ..... **NOVEMBER 15-20, 1952.**

ASA MEETING—34th annual meeting of the American Standards Association, at the Waldorf Astoria Hotel, New York, N. Y. Secretary of the Association, 70 East 45th Street, New York. ..... **NOVEMBER 19, 1952**

ASME MEETING—Annual meeting of the American Society of Mechanical Engineers, at the Hotel Statler, New York, N. Y. C. E. Davies, secretary of the Society, 29 West 39th St., New York, N. Y. ... **NOVEMBER 30-DECEMBER 5, 1952**

NATIONAL POWER SHOW—20th National Exposition of Power and Mechanical Engineering, under the auspices of the American Society of Mechanical Engineers, at Grand Central Palace, New York, N. Y. Charles F. Roth, manager of the Exposition, Grand Central Palace, New York 17, N. Y. ..... **DECEMBER 1-6, 1952**

AUTOMOTIVE ENGINEERS MEETING—Annual meeting and engineering display of the Society of Automotive Engineers, at at the Sheraton-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 West 39th St., New York, N. Y. ..... **JANUARY 12-16 1953.**

HEATING WHOLESALERS MEETING—The annual meeting of the National Heating Wholesalers Association, Inc., at the Congress Hotel, Chicago, Ill. E. L. Wyman, executive secretary of the Assaciation, 637 Union Commerce Building, Cleveland 14, Ohio. ..... **JANUARY 26-28, 1953.**

ASHVE EXPOSITION—The Air Conditioning Exposition, under the auspices of The American Society of Heating and Ventilating Engineers, at the International Amphitheatre, Chicago, Ill., to be held in conjunction with the society's 59th annual meeting. Write to exposition management, International Exposition Co., Inc., Grand Central Palace, New York 17, N. Y. ..... **JANUARY 26-30, 1953.**

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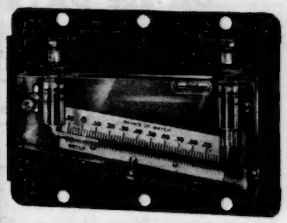

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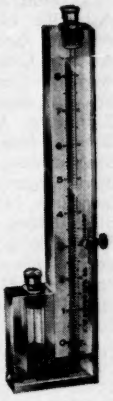

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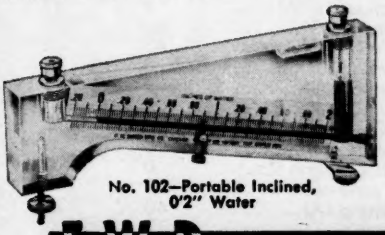

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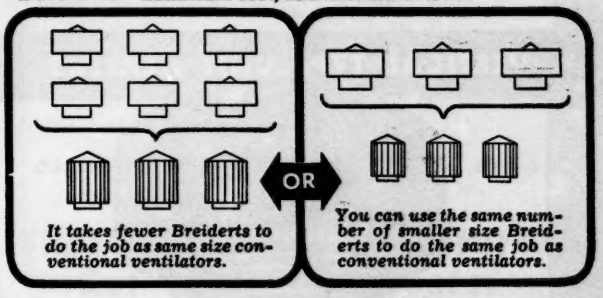

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DEGREE DAYS FOR JUNE, 1952

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 24th Year of Publication of Monthly Degree-Day Data

City	June		
	1952	1951	Normal
Abilene, Texas (A)	0	5	0
Albany, New York (A)	21	60	0
Albuquerque, New Mexico (A)	6	5	0
Alpena, Michigan (C)	132	136	138
Anaconda, Montana (C)	(a)	399	251
Asheville, North Carolina (C)	0	2	0
Atlanta, Georgia (C)	0	0	0
Atlantic City, New Jersey (C)	4	29	0
Augusta, Georgia (A)	0	0	0
Baker, Oregon (C)	215	227	213
Baltimore, Maryland (C)	1	10	0
Billings, Montana (A)	49	246	60
Binghamton, New York (C)	38	69	0
Birmingham, Alabama (A)	0	0	0
Bismarck, North Dakota (A)	49	189	45
Block Island, Rhode Island (A)	26	92	99
Boise, Idaho (A)	87	106	0
Boston, Massachusetts (A)	4	63	0
Bozeman, Montana (C)	(a)	389	230
Buffalo, New York (A)	43	42	12
Burlington, Iowa (A)	3	34	(a)
Burlington, Vermont (A)	(a)	80	3
Butte, Montana (C)	(a)	424	236
Cairo, Illinois (C)	0	3	0
Charleston, South Carolina (C)	0	0	0
Charlotte, North Carolina (C)	0	0	0
Chattanooga, Tennessee (A)	0	0	0
Cheyenne, Wyoming (A)	40	308	126
Chicago, Illinois (C)	17	70	59
Cincinnati, Ohio (C)	0	0	0
Cleveland, Ohio (A)	26	13	0
Columbia, Missouri (A)	0	14	0
Columbia, South Carolina (C)	0	0	0
Columbus, Ohio (C)	0	7	0
Concord, New Hampshire (A)	36	108	54
Concordia, Kansas (C)	0	44	0
Dallas, Texas (A)	0	0	0
Davenport, Iowa (C)	5	35	0
Dayton, Ohio (A)	2	10	0
Deer Lodge, Montana (C)	(a)	389	235
Denver, Colorado (C)	0	164	0
Des Moines, Iowa (A)	1	54	0
Detroit, Michigan (A)	14	32	0
Devils Lake, North Dakota (C)	76	204	96
Dodge City, Kansas (A)	0	50	0
Dubuque, Iowa (C)	19	79	0
Duluth, Minnesota (C)	181	263	216
Eastport, Maine (A)	206	265	300
Elkins, West Virginia (A)	24	38	0
El Paso, Texas (A)	0	0	0
Ely, Nevada (A)	224	(a)	(a)
Erie, Pennsylvania (C)	31	36	0
Escanaba, Michigan (C)	117	167	138
Evansville, Indiana (A)	0	5	0
Fargo, North Dakota	49	147	98
Fort Smith, Arkansas (A)	0	0	0
Fort Wayne, Indiana (A)	5	26	0
Fort Worth, Texas (A)	0	0	0
Fresno, California (A)	9	2	0
Galveston, Texas (C)	0	0	0
Grand Junction, Colorado (A)	4	49	0
Grand Rapids, Michigan (A)	21	58	0
Green Bay, Wisconsin (C)	64	124	0
Greensboro, North Carolina (A)	0	1	0
Greenville, South Carolina (A)	0	0	0
Harrisburg, Pennsylvania (A)	12	28	0
Hartford, Connecticut (A)	7	54	0
Hatteras, North Carolina (C)	0	1	0
Havre, Montana (C)	89	251	144
Helena, Montana (A)	160	336	171
Houston, Texas (C)	0	0	0
Huron, South Dakota (A)	12	130	0
Indianapolis, Indiana (A)	0	13	0
Jackson, Mississippi (A)	0	0	0
Kansas City, Missouri (A)	0	20	0
Knoxville, Tennessee (A)	0	0	0
La Crosse, Wisconsin (A)	26	53	0
Lander, Wyoming (A)	67	303	135

(a) Data not available.

City	June		
	1952	1951	Normal
Lansing, Michigan (A)	36	50	0
Lewiston, Maine (O)	23	122	45
Lincoln, Nebraska (C)	0	53	0
Little Rock, Arkansas (A)	0	0	0
Livingston, Montana (C)	(a)	322	142
Los Angeles, California (C)	17	7	0
Louisville, Kentucky (A)	0	0	0
Lynchburg, Virginia (A)	0	1	0
Macon, Georgia (A)	0	0	0
Madison, Wisconsin (C)	26	56	0
Marquette, Michigan (C)	132	259	186
Memphis, Tennessee (A)	0	0	0
Meridian, Mississippi (A)	0	0	0
Milwaukee, Wisconsin (A)	55	115	39
Minneapolis, Minnesota (A)	21	78	0
Moline, Illinois (A)	6	37	(a)
Montgomery, Alabama (A)	0	0	0
Nantucket, Massachusetts (A)	69	140	123
Nashville, Tennessee (A)	0	0	0
New Haven, Connecticut (A)	13	53	0
New Orleans, Louisiana (C)	0	0	0
New York, New York (C)	10	29	30
Nome, Alaska† (A)	(a)	765	973
Norfolk, Virginia (C)	0	2	0
North Head, Washington (C)	335	301	309
North Platte, Nebraska (A)	0	124	0
Oakland, California (C)	143	132	93
Oklahoma City, Oklahoma (C)	0	8	0
Omaha, Nebraska (A)	0	57	0
Oswego, New York (C)	70	78	63
Parkersburg, West Virginia (C)	1	3	0
Peoria, Illinois (A)	4	24	0
Philadelphia, Pennsylvania (C)	7	21	17
Phoenix, Arizona (C)	0	0	0
Pittsburgh, Pennsylvania (C)	3	2	0
Pocatello, Idaho (A)	104	174	60
Portland, Maine (A)	47	171	81
Portland, Oregon (C)	122	48	90
Providence, Rhode Island (C)	7	54	0
Pueblo, Colorado (A)	0	81	0
Raleigh, North Carolina (C)	0	0	0
Rapid City, South Dakota (A)	27	220	30
Reading, Pennsylvania (C)	10	24	0
Red Bluff, California (A)	29	0	(a)
Reno, Nevada (A)	187	104	90
Richmond, Virginia (C)	0	0	0
Rochester, New York (A)	45	53	0
Roswell, New Mexico (A)	0	11	0
Sacramento, California (C)	33	9	0
St. Joseph, Missouri (A)	0	21	0
St. Louis, Missouri (C)	0	7	0
Salt Lake City, Utah (A)	41	(a)	0
San Antonio, Texas (A)	0	0	0
San Diego, California (A)	30	4	6
Sandusky, Ohio (C)	4	15	0
San Francisco, California (C)	245	257	195
Sault Ste. Marie, Michigan (A)	204	238	189
Savannah, Georgia (A)	0	0	0
Scranton, Pennsylvania (C)	26	49	0
Seattle, Washington (C)	177	82	162
Sheridan, Wyoming (A)	85	273	120
Shreveport, Louisiana (A)	0	0	0
Sioux City, Iowa (A)	1	68	0
Spokane, Washington (A)	139	129	81
Springfield, Illinois (C)	0	16	0
Springfield, Missouri (A)	0	15	0
Syracuse, New York (A)	42	65	12
Tacoma, Washington (C)	215	122	183
Terre Haute, Indiana (A)	0	15	0
Toledo, Ohio (A)	7	25	0
Topeka, Kansas (C)	0	19	0
Trenton, New Jersey (C)	12	29	0
Utica, New York (O)	73	61	0
Valentine, Nebraska (C)	9	172	0
Walla Walla, Washington (C)	63	47	0
Washington, D. C. (C)	0	9	0
Wichita, Kansas (A)	0	19	0
Williston, North Dakota (C)	66	185	0
Winnemucca, Nevada (C)	196	136	117
Yakima, Washington (A)	109	46	0

(a) Data not available. †Nome data are for May.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

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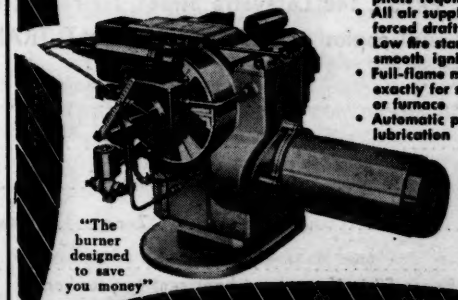

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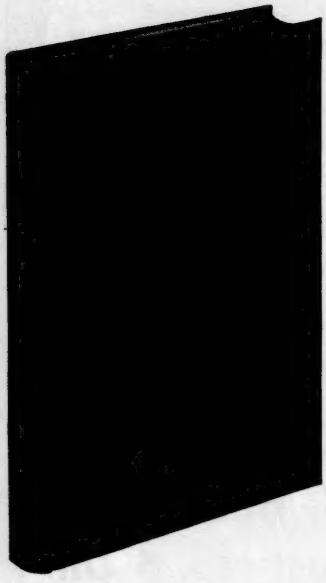

The author, F. W. Hutchinson, is Professor of Mechanical Engineering at the University of California. His knowledge of heat transfer is well-grounded on practical experience as well as theory, as he acts as consultant on heat transfer problems for many industrial firms.

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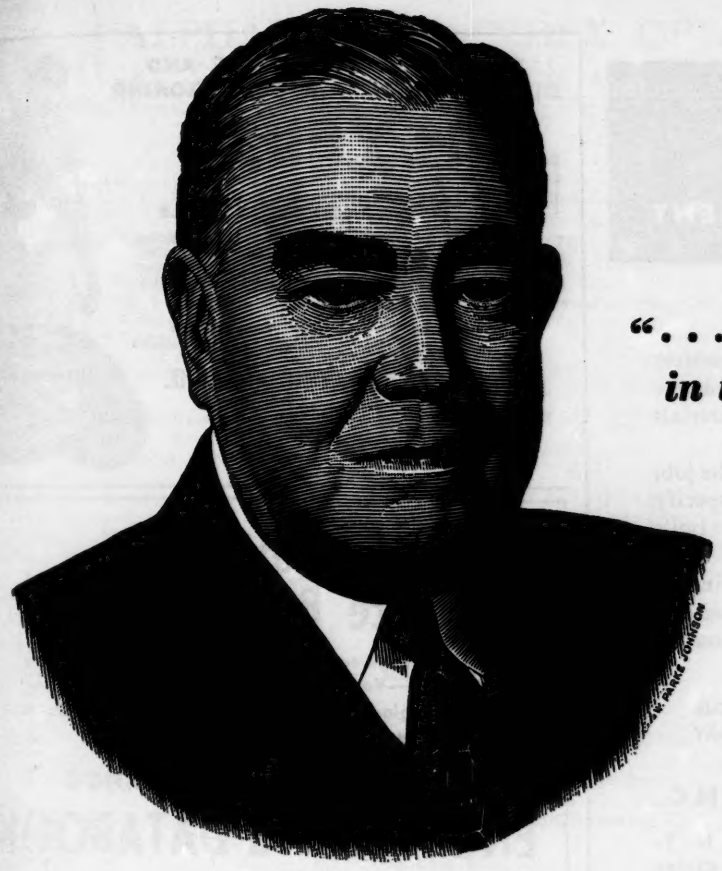

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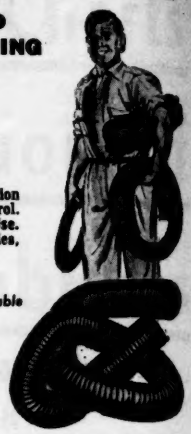

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ALPHABETICAL INDEX OF ADVERTISERS

A

Acme Industries, Inc. 56
Aerofin Corp. 46
Air Devices, Inc. 18
Air Filter Corp. ..... *
Air-Maze Corp. 38
Alco Valve Co. ..... *
Allen-Bradley Co. 30
Allen Ventilator Div., Production Planning Co. ..... *
Allen, W. D. Manufacturing Co. .. 133
American Air Filter Co., Inc. 9
American Blower Corp. ..... Insert 17
American District Steam Co., Inc. ... 51
American Machine and Metals, Inc. 1
American Radiator & Standard Sanitary Corp. 59
American Solvent Recovery Corp. *
American Ventilating Hose Co. 144
American Wheelabrator & Equipment Corp. 126
Ames Iron Works ..... *
Anemostat Corp. of America 15
Arabol Mfg. Co. 145
Armstrong Machine Works Inside Front Cover
Auer Register Co. ..... *

B

Babcock & Wilcox Co., Tubular Products Div. 50
Barber-Colman Co. 8
Barnes & Jones, Inc. ..... *
Bell & Gossett Co. 47
Bethlehem Steel Co. ..... *
Binks Manufacturing Co. 133
Bishop & Babcock Mfg. Co. 137
Breidert, G. C., Co. 139
Brunner Manufacturing Co. 5
Bryant Heater Div., Affiliated Gas Equipment, Inc. 61
Buffalo Forge Co. 28-29
Builders-Providence, Inc. ..... *
Bundy Tubing Co. 41
Byers, A. M., Co. ..... *

C

Carrier Corp. 24
Chase Brass & Copper Co. ..... *
Chicago Pump Co. ..... *
Clarage Fan Co. ..... Inside Back Cover
Classified Advertisements 144
Cleaver-Brooks Co. 141
Combustion Engineering-Superheater, Inc. 22
Committee on Steel Pipe Research. *
Connor, W. B., Engineering Corp. 21-125
Copeland Refrigeration Corp. 27
Coyne & Delany Co. 67
Crane Co. ..... *
Curtis Refrigerating Machine Div., Curtis Manufacturing Co. 31
Cyclotherm Div., United States Radiator Corp. ..... *

D

Davis Engineering Corp. ..... *
Debothezat Fans Div., American Mch. & Metals, Inc. 1
Delco Products Div. of General Motors Corp. 49
Dillon, W. C. & Co. 133
Dunham, C. A., Co. 20
Durant Insulated Pipe Co. 139
Dwyer, F. W., Mfg. Co. 139

E

Electromode Corp. ..... *
Elgo Shutter & Mfg. Co. ..... *
Emerson Electric Manufacturing Co. *

F

Fairbanks Co. ..... *
Fedders-Quigan Corp. ..... *
Field Control Div., H. D. Conkey & Co. 45
Fitzgibbons Boiler Co., Inc. 26
Flexonics Corporation ..... *

G

Gallaher Company ..... *
General Electric Co. ..... *
Governair Corporation ..... *
Grinnell Co., Inc. ..... *

H

Halstead & Mitchell 52
Harrington & King Perforating Co. . *
Hays Corporation ..... *
Henry Valve Co. 2
Hoffman Specialty Mfg. Corp. 19

I

Illinois Engineering Co. ..... *
Illinois Testing Laboratories, Inc. . . *
Industrial Press Co. 142
Industrial Sound Control, Inc. 137
Infra Insulation, Inc. 69
Iron Fireman Manufacturing Co. . . *

J

Jenkins Bros. 23
Johnson Corporation ..... *
Johnson Service Company . . . Back Cover
Joy Manufacturing Co. 123

K

Kennard Corp. ..... *
Kennedy Valve Mfg. Co. ..... *
Koppers Co., Inc. 138
Kramer Trenton Co. 127
Kuhns Brothers Co. ..... *

L

Ladish Co. ..... Insert 35

M

Marley Company, Inc. 64
Marlo Coil Co. ..... *
Marsh Heating Equipment Co. 44
McCord Corporation 140
McDonnell & Miller, Inc. 39
McQuay, Inc. 43
Minneapolis-Honeywell Regulator Co. 10-11
Modine Manufacturing Co. ..... *
Muckle Manufacturing Co. 134
Mueller Brass Co. 135

N

Nash Engineering Co. 70
National Tube Div. United States Steel Co. 16
Nelson, Herman Div., Amer. Air Filter Co., Inc. ..... *
New York Blower Co. ..... *
Niagara Blower Co. ..... *
Nicholson, W. H., & Co. 134

O

Olson, Arthur A., & Co. 130

P

Powder Power Tool Corp. ..... *
Powers Regulator Co. 62-63
Production Planning Co. ..... *

R

Radiant-Ray Radiation, Inc. ..... *
Remington Arms Company, Inc. ... 57
Revere Copper & Brass, Inc. 121
Ric-wiL Company ..... *

S

Sarco Co., Inc. 144
Sarcotherm Controls, Inc. ..... *
Servel, Inc. 55
Skidmore Corporation 128
Spence Engineering Co., Inc. 14
Standard Stamping & Perforating Co. 37
Sturtevant Div., Westinghouse Electric Corp. 58
Superior Combustion Industries, Inc. 25
Swartwout Co. 127

T

Taylor Forge & Pipe Works. ..... *
Thrush, H. A., & Co. 42
Titusville Iron Works Co. 132
Trane Co. 12-13
Tube-Turns, Inc. .... Insert bet. 52-55
Tuttle & Bailey, Inc. ..... *

U

Union Asbestos & Rubber Co. ... 60
Unistrut Products Co. 131
United States Air Conditioning Corp. 145
United States Steel Co. 16

W

Wagner Electric Corp. 40
Want Advertisements 144
Warren Webster & Co. ..... *
Watts Regulator Co. 146
Weil Pump Co. 36
Western Engineering & Mfg. Co. .. 137
Westinghouse Electric Corp., Sturtevant Div. 58
Wing, L. J., Mfg. Co. 129
Worthington Corp. 34

Y

Yarnall-Waring Co. 7
York Corporation 33
York-Shipley, Inc. 136
Young Radiator Co. 65
Youngstown Sheet & Tube Co. ... 48

*Advertisement appeared in preceding issue.

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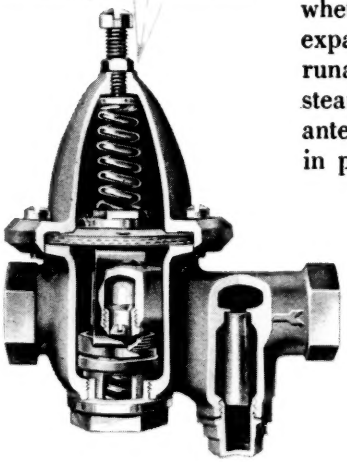
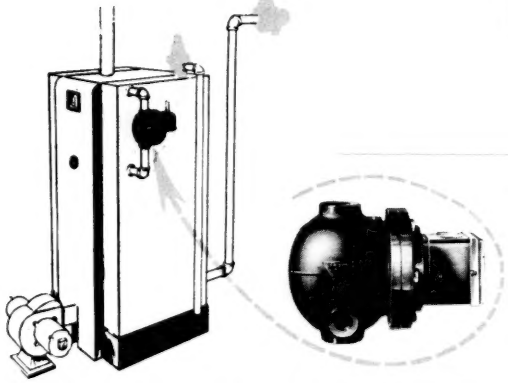
THE NO. 74 safeguards against any pressure rise in the system, whether it be simple thermal expansion, or steam caused by runaway firing. Its high BTU steam discharge capacity guarantees against any further rise in pressure above 30 lbs.

THE NO. 135HW automatically responds to any need for make-up water, if the pressure drops below 12-15 lbs. This assures an adequate supply of water and maintains minimum pressure requirements in the system at all times.





P.S. If, for any reason, the water supply to the boiler should fail and a dangerous low water condition should occur in the boiler, a Watts No. 50A low water cut-off will prevent damage to the boiler in this *extreme* emergency. The No. 50A low water cut-off was designed to offer this additional protection if it is specified.

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SOLAR RADIATION IN COOL AND COLD MONTHS

The accompanying charts, prepared by Sigmund Fritz and Torrence H. MacDonald of the U. S. Weather Bureau, show the *average daily* amounts of solar radiation received on a horizontal surface throughout the U. S. The average is of all days for each month. The quantities are expressed in langleys, a unit abbreviated to ly, one langley being one gram-calorie per square centimeter. If the lys are multiplied by 3.69, the result will be in Btu per square foot.

In other words, the figures from the maps multiplied by 3.69 will give the Btu falling on a horizontal square foot per average day in that month, and the average includes all days regardless of degree of cloudiness.

The solar radiation data were collected from stations at Blue Hill, Mass.; Newport, R. I.; Madison, Wis.; Twin Falls, Idaho; Washington, D. C.; Lincoln, Neb.; Fresno, Calif.; Riverside, Calif.; New Orleans, La.; La Jolla, Calif.; and Miami, Fla. Data for other locations were calculated as explained by Messrs. Fritz and MacDonald in HEATING AND VENTILATING, July, 1949.

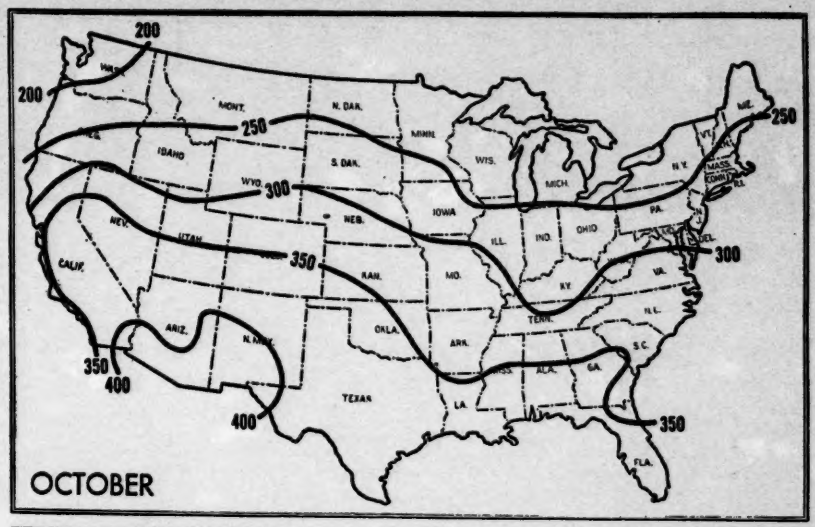
An example of the use of the charts is as follows:

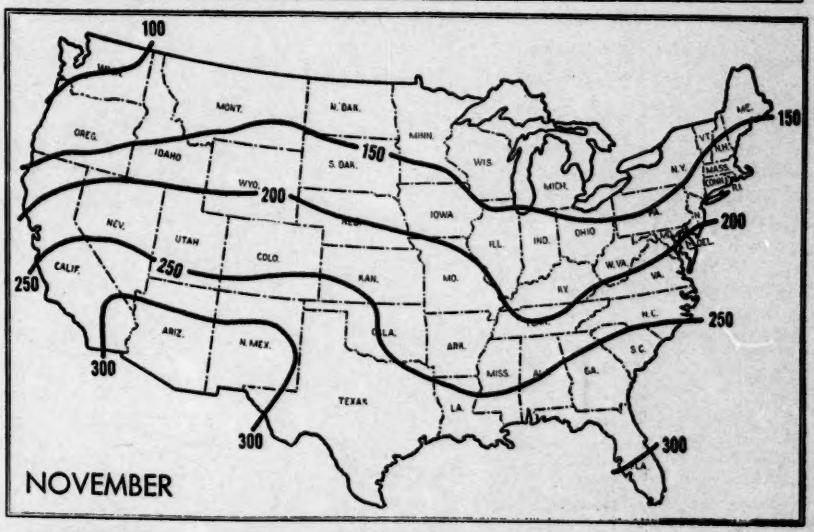
Example. What would be the total heat received from the sun by a horizontal surface during December, January and February in Chicago, Ill.?

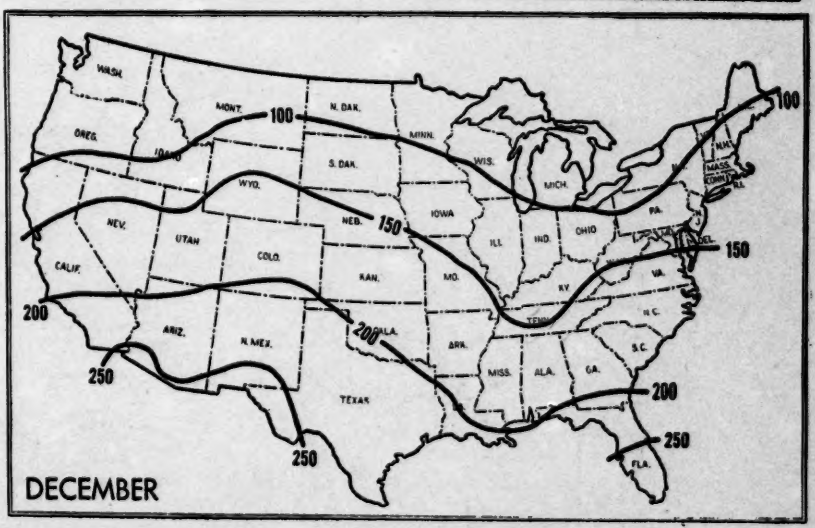
Solution. From the charts, by interpolation, the figures are 110, 125 and 210 ly per average day for December, January and February, respectively. Converting to Btu per month the figures would be

Dec. $110 \times 3.69 \times 31 = 12{,}583$
Jan. $125 \times 3.69 \times 31 = 14{,}299$
Feb. $210 \times 3.69 \times 28 = 21{,}697$

Total Btu per sq. ft. 48,579







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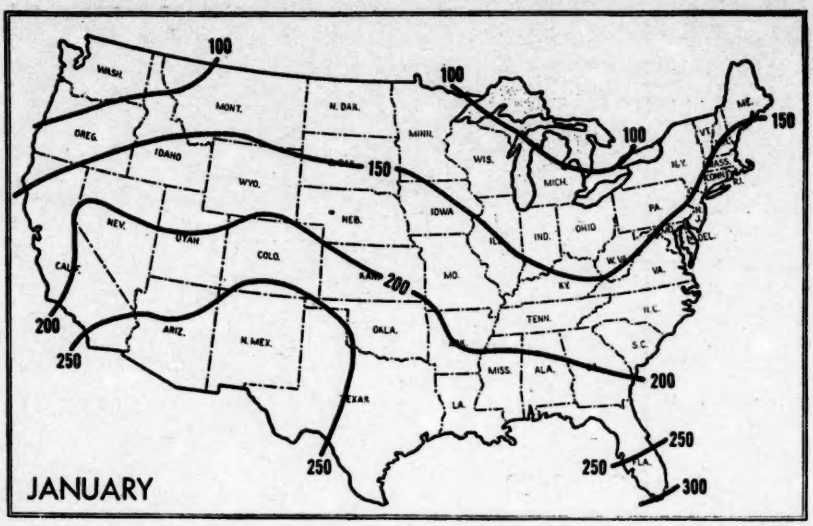

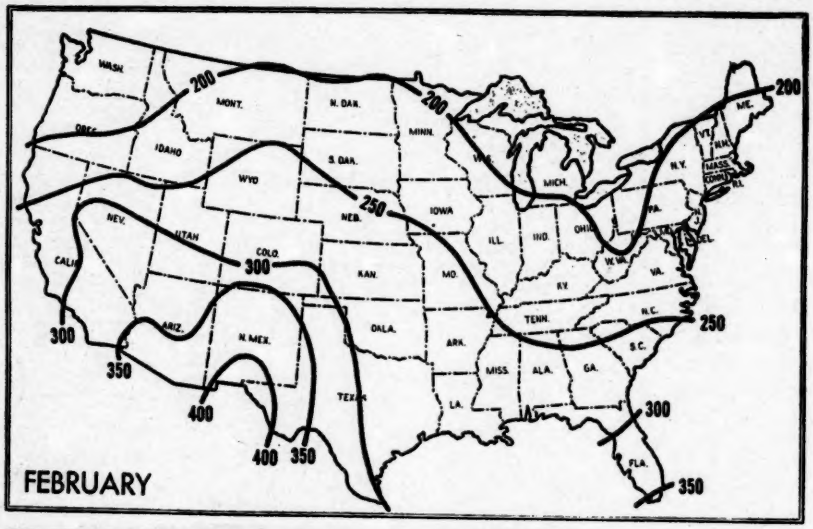

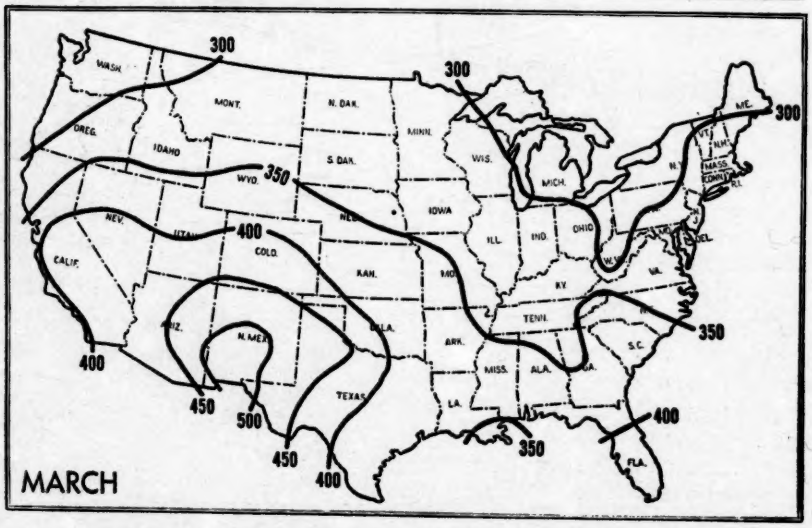

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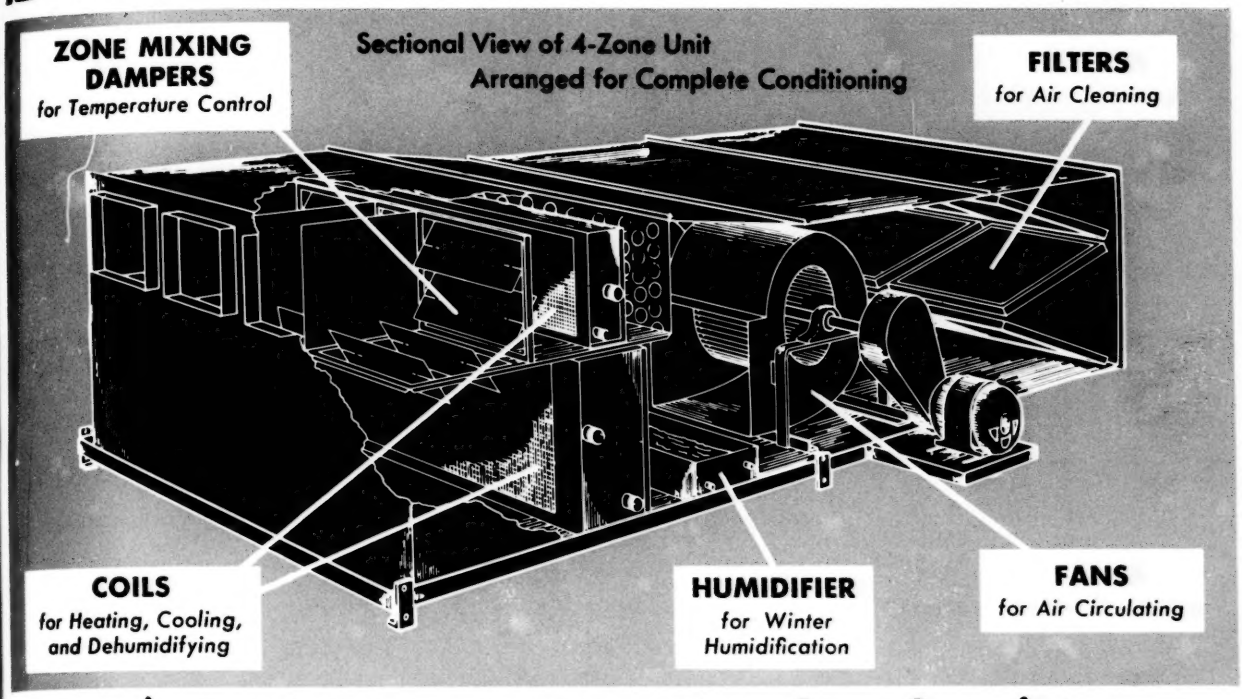

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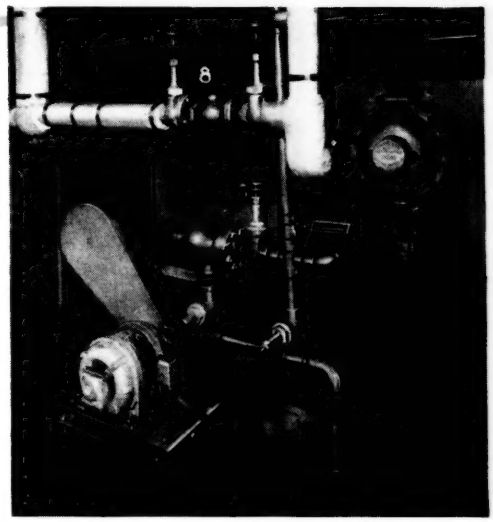

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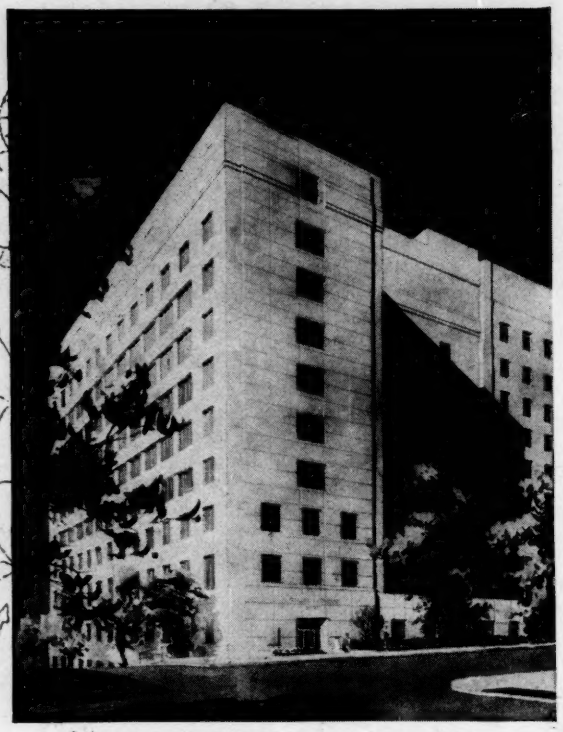

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